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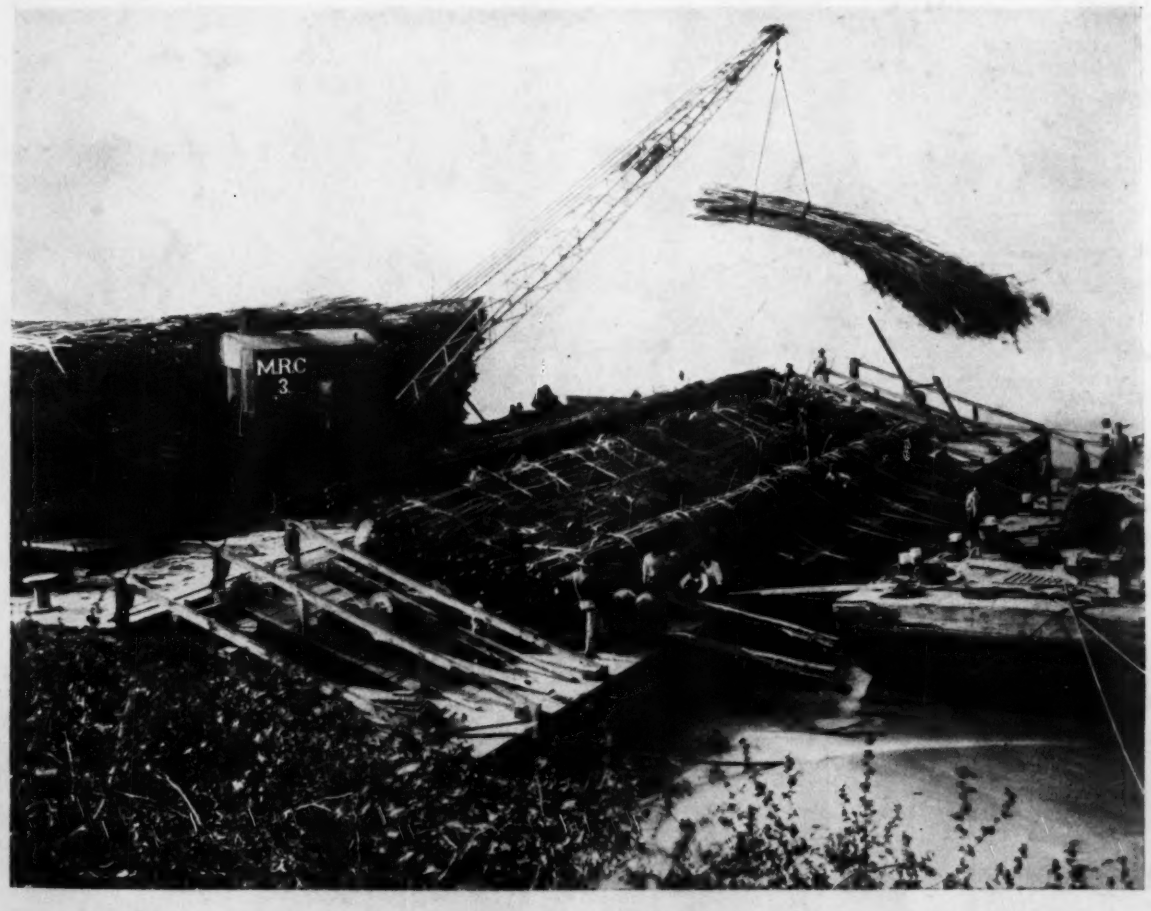
How the Mississippi River Is Regulated, by Col. C. L. Potter—Checking Up on Profit During Construction, by Beardsley Lawrence—Improved Methods Cut Upkeep Costs of Concrete Roads, by H. J. Friedman—Reconstruction of Die House at a Textile Mill



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DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

FRANK C. WIGHT
Editor

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Subduing the Father of Waters

ONCE every five or ten years the Mississippi becomes first-page news. Every day for a week or so the people of the whole country read of the daily gages from Cairo to the Passes and the rotogravures and news reels show houses floating across a shoreless inland sea and long lines of darkies, mules and carts dumping earth on topped levees. Then the waters go down and the country forgets the big river. But all the time from St. Paul to the gulf this same river is working away at its bounds, striving always to change its course, wandering hither and yon across its numerous channels, and all the time there are men whose lifework it is to keep it under control, so that it will be a service and not a menace to those who live in its valley. It is more than a battle which occasionally gets public notice; it is a war, the end of which is not in sight. But the campaign has long been mapped out and the campaigners are veterans. As it is an engineering war, and one of the greatest of civil engineering wars, it is proper that engineers should know more about it than the casual and occasional stories that come to them in flood time. For that reason we take pleasure in presenting—in this calm period between battles—Colonel Potter's story of how the Mississippi war is being fought.

Leasing Dates and Labor

PROMINENT among the hindrances to year-around employment in construction, is the present prevalence of leasing on fixed or common dates as May 1 and Oct. 1. This statement applies particularly to building construction and to buildings for residence rather than for business purposes. In general the office and business building lease begins and ends in any month of the twelve as may happen. Residence property in a large measure, however, has one leasing date in the fall and one in the spring, and building is scheduled for completion with definite relation to these dates. The effect is to place peaks in the demand for construction labor but more particularly in the demand for labor engaged in renovating and repairs, in moving and storage and in meter installation and connections for water, gas, light and telephone services. So intensely seasonal have these operations become that firms and corporations which provide such services are forced to extremes in employing overtime; in accepting inefficient and unqualified workmen, and in piling up materials and supplies for rush periods. While recognition of the facts mentioned has been common there are few statistics of the extent of the seasonal condition of renovation and repair and of the several operations. We need these figures. Much less, however, is our determined knowledge of the causes responsible for the present practice of fixed fall and spring leasing dates, of the reasons upholding the practice, of the possibilities of affecting changes and of the gains and losses which might be expected to follow the changes. Study is needed to amend this condition. Could residence renting be as evenly distributed throughout the year as is renting for business uses a very long step would be taken toward the reduction of seasonal employment in the construction trades.

Gasoline Taxes Grow

FROM current reports from legislatures in session, there appears no decrease in the disposition to impose state taxes on gasoline for motor vehicles. As of Jan. 1, this year, there were 35 states which taxed gasoline from 1 to 4c. a gallon. With perhaps two or three exceptions the legislatures of the remaining states have this winter been called upon to consider gasoline tax laws. Indeed two states, Kansas and Michigan, have enacted such laws. Three other states, which had laws, have, since Jan. 1, increased the tax rate. North Carolina as well as Arkansas now has a 4c. gasoline tax. Only six states have the minimum rate of 1c. a gallon. Seventeen states have a 2c. tax and fifteen have a tax exceeding two cents. The trend is apparent. As one observer said recently: "Every state without one is considering a gas tax and every state with a gas tax is considering a bigger one." Probably this condition is not quite true but it is certain that the public has put the stamp of its approval on gasoline taxation for road building and is moreover not afraid to press continually higher imposts. The prophecy two years ago of one or two bold souls among highway engineers that a 5c. gas tax was near, has been very nearly fulfilled. Last year, 1924, the income of 35 states from their gasoline taxes was almost $80,000,000, and the thirteen states without taxes registered nearly half of all the motor vehicles.

Floods Wanted

A SITUATION not unlike that on the old Nile exists at one place in California. The story always has been that Egypt lived only because the Nile overflowed each year and created thereby the fertile ground on which the Egyptians grew their crops. A downstream owner on the San Joaquin River has just now obtained an injunction restraining a power company from further impounding of certain flood waters on the ground that such waters, if unrestrained, would overflow its land and thus replenish the ground water, which is necessary to the existence of those on the land. The court upheld the claim, saying that the downstream rights to the flood water were in this case evident and of long standing. Running water is a troublesome thing for the law. So many rights are involved in its use; irrigation, navigation, hydraulic mining, sanitation, power. It is novel, however, to find that there is, too, a right to have a flood overflow one's land; especially novel in these days when so many millions are being spent to do just the opposite.

What Is Good Concrete?

CONCRETE is a universal construction material. There are specialists in its design and its making and placing but every engineer and every builder has to use a certain amount of it and has to have, or least ought to have, more than a rudimentary knowledge of its necessities and peculiarities. No subject is more widely discussed when raised among engineers than the making of concrete, not only because of this universality of its use but because concrete itself is neither completely satisfactory in use nor completely standardized in its manner of production. Every engineer has his own observation of eccentric behavior to report and his own technique to defend—which in itself is the beginning of argument. But such argument more often than not gets nowhere or at least creates only misunderstanding because the participants do not start on a common ground. Each assumes that what he is trying to do is to make good concrete but nobody takes the trouble to define just what good concrete is.

Good concrete fundamentally is concrete which serves the purpose for which it is intended. It is not, therefore, a fixed, immovable standard, but changes with conditions. Concrete plenty good enough for a dry subterranean foundation would be the poorest sort of material for a high pressure pipe line or a seawater pier. And service, varying at it does for varying structures and uses, is something more than the ability to meet a momentary condition; it is the satisfaction of all the conditions that the structure must meet during its economic life. Failure to appreciate this distinction is the natural result of the dominance of the theory of structural design in concrete.

For that theory holds strength to be the governing consideration in structures. Loads are assumed, the stresses they induce are distributed throughout the structure according to known or assumed laws and the members are proportioned to meet those stresses according to some assumption of what the given material can safely stand, an assumption predicated upon what similar material has stood either in structure or in test. Strength, the continuing strength of a homogenous material which has the same strength everywhere, is the controlling element. All else is secondary.

Unfortunately, this strength, which has been so overemphasized in design, is the least difficult thing to assure in concrete and after all the least important of its desired qualities. Concrete failures of the kind that are called failures but which are more specifically collapses are rarely due to lack of strength. They are due to inadequate design or improper construction, to neglect of details of connections, to insufficiency of material or to obviously dangerous expedients in erection. The concrete itself, even though of low unit strength, is rarely so weak that it would not have been sufficient had proper design and construction precautions been taken. Under any normal method of design the unit strength would have to be much less than half that assumed if the concrete is actually to fail, suddenly and directly under load. Concrete has been placed so poor in quality and consequently in strength that such failure does take place, but that is just ignorance or carelessness or worse—and it is comparatively rare in important work just as poor workmanship is rare in any of the crafts.

But there are other qualities of concrete beside unit strength that structural design does not take into account and these are the qualities which are most important in making "good" concrete. They are the qualities which insure stability and homogeneity. They are density, and low expansibility, and high resistance to weather and to wear.

We know really very little about these qualities of concrete, that is very little quantitatively. We know that some concrete has high resistance, that it wears well under adverse exposure, that it is dense and non-cracking. Such concrete sometimes has a high strength and sometimes not; certainly its strength is no absolute measure of its resistance to the attacks of time as it is a measure of ability to withstand load. We know that other concrete of high strength and early admirable appearance succumbs to the attack of time long before it succumbs to the continuing pressure of load. There is a relation, of course, between strength and wear. By and large, the strongest concrete will resist other attack best, but it is by no means a law nor is there evidence yet of any formula by which strength and wear can be correlated.

There is a distinction between designing a good concrete structure and making good concrete. It is not enough to be able to build a structure which does not fall down, nor sag nor crack under its appointed load. The builder of concrete should strive to make concrete that will stand the years as well as the tons—and if any such builder feels that this is an easy task or that to insist upon its being done is academic, let him take a few days off and make a close examination of some of the outdoor concrete he put in ten years ago.

And so when we talk about good concrete we ought to agree on what we mean by the term. It is no defense of certain types of structures to say that there are no records of collapse among them, if every other one of them is in process of obvious decay, is wearing out rather than breaking down. It is little solace to the owners of a certain stadium that a piece of concrete taken from one of its columns will test 3,000 lb. per sq. in., if the structure is ugly with cracks and rods lie exposed to the rain and the sun. Good concrete is concrete which does its appointed work day in and day out, year after year, with no more change than that which takes place in a comparable natural stone, which presents a smooth-grained surface, which does not crumble and ravel. It may crack in places under excess strain there but that does not take away from it the claim to be good; it means only that its designer failed to recognize or to discover certain stress conditions. It must be as cheap as possible, and in insuring that the designer can exercise ingenuity not only in the arranging and detailing of his structure but in the selection and proportioning of his concrete materials. It must obviously be as strong as it need be and no stronger. But above all it must last through the period of its economic life, that is until it would be cheaper to replace it than to have provided for a longer life. And it must last that long in a presentable state, for in most outdoor concrete structures appearance is of great importance.

To make such good concrete is the end of all the studies that are being made toward more scientific proportioning and mixing and placing. Some of these—most of them indeed—are too complicated. They still smell too strongly of the laboratory. But that is an evil that will be overcome. There is more than a chance

that the carefulness of preparation and the observance of fixed rules of manufacture which are a part of the more scientific making of concrete tend to a uniformity of product and a closer approach to an optimum product, both of which mean a concrete which, while not necessarily of greater strength, should certainly be of greater wear resistance than the best of the rule-of-thumb concrete of earlier days. And that greater wear resistance, after all, is what makes good concrete.

Storm Fury and Human Works

FOR the second time within a year the tragedy of widespread tornado destruction and death is recorded, this time with an unprecedented number of victims. No storm for years past compares with the Illinois whirlwind in its destructive effects. The Ohio tornado of last June was small in comparison.

According to the scanty available reports, the work of the storm was quite the same as that of other whirlwinds. Houses, groups of houses and entire communities were destroyed completely, by indiscriminate crushing, tearing apart, or overthrowing. Whether engineering structures were involved, and if so whether they too were destroyed, is not known at this time, but ordinary buildings such as dwelling houses, and business structures of light kind, were everywhere wrecked —if they survived it presumably was due to their not being struck by the active portion of the erratically leaping tornado.

Long ago the prairie regions farther west, a country familiar with whirlwinds since its earliest settlement, devised the "cyclone cellar" as refuge. Safety could be found only below ground level, the settlers had learned; every human edifice above ground was doomed if it lay in the storm's path. We appear to be in the same situation today as regards the ability of our ordinary buildings to withstand these outbursts of nature. But meantime towns and cities have grown up where once there were vast stretches of open country. Today the narrow tornado path is more likely to strike a settled community than a generation ago, and has vastly multiplied potentialities for wreaking havoc. Must we still depend on the cyclone cellar? Must we suffer our homes and working places to be crushed or whirled away when the tornado strikes them?

With the most optimistic outlook on future scientific development, no hope exists that we can ever prevent whirlwinds. Storms like that in Illinois will recur, again and again. Unless, then, we are content to have the history of broadcast ruin repeat itself indefinitely, the question will have to be answered whether houses and towns can be built to withstand whirlwinds, and how this may be accomplished. No approach has yet been made toward answering this question. But in the Illinois ruins there are data which will go far toward supplying the answer. If they can be made to yield these data the disaster will have returned some small fraction of the heavy toll it took.

Little is known today of whirlwind forces—practically nothing. All that can be learned about resistance to whirlwinds remains for the future to learn. No fuller opportunity for acquiring such knowledge has presented itself than the Illinois visitation. The opportunity is such, in fact, as to invite thorough and prompt co-operation of technical authorities to carry out the necessary study.

Fortunately the agencies which can join in undertaking the study are not wanting. The Public Works Department of the state, the University of Illinois, the building authorities of Chicago, St. Louis and Indianapolis, federal authorities such as the Department of Agriculture with its Weather Bureau, and the Department of Commerce with its research and building-code authorities, are near at hand or else are vitally concerned in the problem at issue. Under the lead of the great commonwealth of Illinois itself whose concern is the most immediate, a group of investigators representing these agencies can go out into the field in a short time, with results of a value quite beyond present possibility of estimating. We confidently look to the authorities for action.

Unsound Railroad Finances

NOTHING has served to emphasize the unsound financial condition of some of our railroads as has the receivership of the Chicago, Milwaukee & St. Paul Ry., one of the largest in the country and a railroad that up until 1916 was able to sell all classes of its securities at a premium. To those who have not been following the financial side of railroading, the announcement of the receivership was a great surprise, coming as it did immediately following the announcement that the electrification of the St. Paul line over the Cascade Mountains was a success from a financial as well as an operating viewpoint. Yet, this very electrification was one of the contributory causes of the failure of the system, because it was financed by the issue of bonds. The same is true of the whole extension of the railroad to Puget Sound. It was built about fifteen years ago and financed largely in the same way, a policy which seemed sound at the time because the territory was developing and the prospects for steadily increasing business were good. But more recent developments have upset the calculation of the builders; the war, with its boosting of the cost of labor and materials, the agricultural depression following the war, a depression that hit the Northwest particularly hard, and finally the competition of the Panama Canal, all resulted in an enormous falling off of recent traffic.

In view of this condition and the small prospect of any great increase in the near future in revenue to meet the fixed charges on the road's bond issues, and with $48,000,000 of bonds coming due to June, the directors of the railroad asked for a receivership in order to straighten out its finances as soon as possible and get it back to a point where it can raise the capital needed to maintain its 10,600-mile system. The St. Paul is not alone in its predicament. A few roads are in the hands of receivers, and the New York, New Haven & Hartford just escaped a receivership by having the industries which it serves come to its rescue in meeting a maturing bond issue of $23,000,000. Many other railroads have had to resort to the issue of bonds to finance work which should normally be financed by the issue of stock. This situation is due to a condition which is common to most railroads of the country, insufficient income to meet their operating costs and still have enough left to make their stock an attractive investment. As long as this situation exists, so long can we expect the failure of railroads which would normally be sound properties.

How the Mississippi River Is Regulated

History of the Control of the Great Waterway, with Detailed Description of the Various Types of Works in the Three Sections: the Upper, the Middle, and the Lower River

By Charles L. Potter
Colonel, Corps of Engineers, U. S. A.; President, Mississippi River Commission, St. Louis, Mo.

This is the first of two articles by the President of the Mississippi River Commission on the methods of control on the longest fully regulated river in the world. This article describes the differences in the control systems for the three distinctly different sections of the river. The second article will outline the several proposed schemes for controlling the floods on the lower river and will explain why the Mississippi River Commission sticks to its long established policy of "levees only" for regulation below Cairo. Colonel Potter has had long experience on the River and speaks authoritatively.—Editor.

THE MISSISSIPPI RIVER would have been the longest river in the world, had not fate decreed that the "star of empire" should move westward and that the exploration of the Mississippi River should be downstream. Had the "star of empire" moved eastward from the Pacific Northwest, the route would probably have been up the Columbia, Snake and Clearwater Rivers, through the land of the Nez Perce Indians (now the state of Idaho), over the Bitter Root Mountains by the Lolo Pass, and into the land of the Bannocks—now western Montana. A small eastwardly-flowing stream would have been found, the upper reach of which is unnamed even today. After passing through Upper and Lower Red Rock Lakes, it becomes Red Rock Creek; changes its name again to Beaver Head River; and so continues until it joins the Jefferson—one of the three rivers which unite at Three Forks, Montana, to form the Missouri River, the other two being the Madison and the Gallatin. Knowing the conceit of all explorers (that the stream they are on is the main river, and that all others are tributaries) it is within reason to suppose that whatever name had been applied at the source might have persisted to the Gulf of Mexico—to be changed later to "Mississippi," the Indian name of the lower river—a distance of more than 4,200 miles. The Amazon is 3,800 miles long, the Nile 3,766, the Yangste 3,400, the Yenisei 3,300, and the Congo 3,000 (World Almanac figures).

Had DeSoto (1541), the first white man to see the river (except at its mouth), probably from the Chicasaw Bluffs near Memphis, been an explorer instead of a gold-hunting adventurer, he might have undertaken the exploration of his "Rio Grande." When he reached the junction of the two rivers above St. Louis, his conceit would have been to apply the name to the stream which bade fair to be the longer, and the Missouri would have won. But DeSoto was no explorer.

But the "star of empire" moved westward, guiding those indomitable French priest-explorers across the divide between the Great Lakes and the Mississippi River. Thus by the way of the Fox and Wisconsin Rivers, Father Marquette arrived at the mouth of the Wisconsin and beheld the great river on June 17, 1673—a day that was to be made famous 102 years later by the Battle of Bunker Hill. Even the conceit of the explorer would not warrant his considering the Mississippi as a tributary of the Wisconsin. But once he was embarked on his "Riviere de la Conception" (as he named it) nothing else stood a show. He was on the main river and all others were tributaries. It may be judged from his description of the tributary and the main river below—muddy water, swift current, floating trees and islands, etc., etc.—that the Missouri was in the throes of a June rise, delayed a little as he was there July 1, 1673. If so, it may have had several times the volume of flow of the Upper Mississippi, and yet it didn't stand a show. It was a tributary and was named, then and there, the "Missouri" after a tribe of Indians living in that vicinity. It could not be the main river. Father Marquette's pride would not allow it.

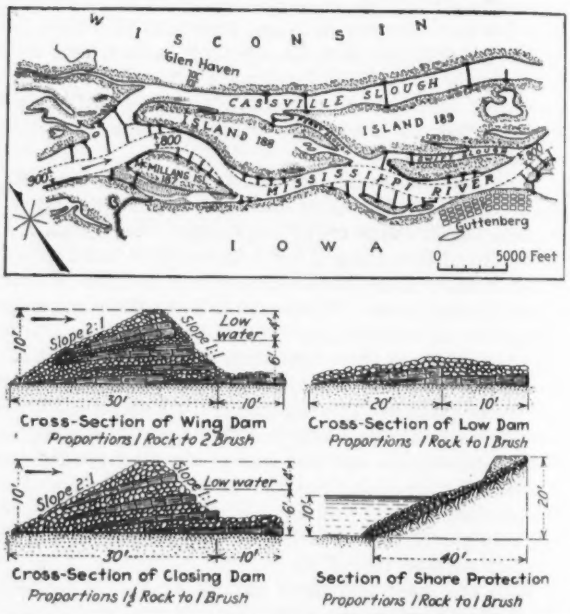


FIG. 1—A TYPICAL SECTION OF THE UPPER MISSISSIPPI SHOWING METHOD OF CONTROL

Note that channel is reduced in width below the head of Island No. 188 and an opening left in the dike there. This is to force enough water in front of Glen Haven to keep that channel and Ferry Slough open for the ferry to Guttenberg. The dams in Cassville Slough are low dams, allowing a flow over them. Below Cassville Slough the main channel is again widened to 900 ft.

So the Mississippi River is only 2,475 miles long (being the twelfth longest in the world), and changes its character so decidedly at two points that it is divided, and so treated from an engineering standpoint, into three sections—the Upper Mississippi, from Minneapolis (the Falls of St. Anthony) to the mouth of the Missouri; the Middle Mississippi, from there to the

mouth of the Ohio; and the Lower Mississippi, from Cairo to the Head of the Passes.

The control of this river, as a matter of flood protection and to improve navigation, goes back to the

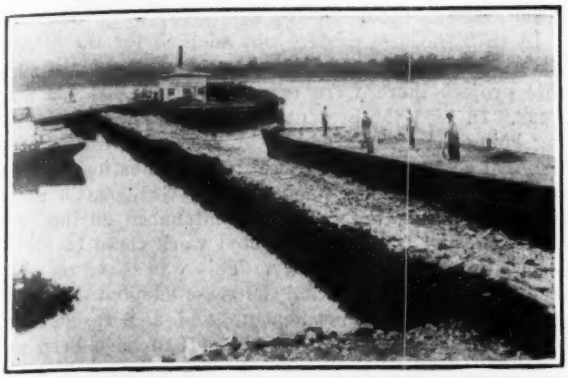


FIG. 2—WING DAM, ON UPPER MISSISSIPPI IMPROVEMENT, UNDER CONSTRUCTION

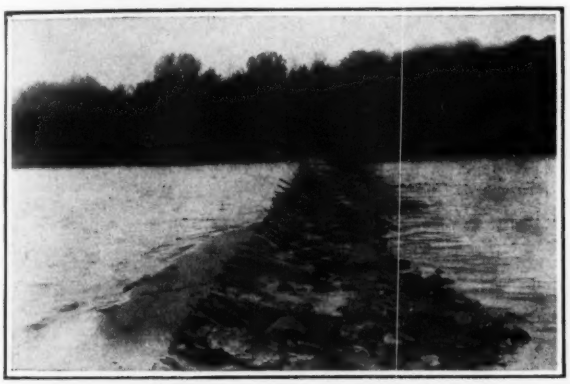


FIG. 3—WING DAM ON UPPER MISSISSIPPI AFTER EXPOSURE FOR A FEW YEARS

early days of the settlement of its valley. Levees were commenced, for instance, in the lower river as far back as 1717, and in 1837 Lieut. Robert E. Lee, of the U. S. Corps of Engineers, built some dikes at St. Louis. It was not until 1872, however, that the federal government initiated any systematic plan for control. Since that time the improvement has gradually become more extensive until now the whole river is under some kind of regulation, varying with the nature and the demands of the section. It will make the description of these operations more intelligible if they are described by sections, together with a description of the physical nature of the several sections.

Nature of River Improvement

Upper River—The Upper River extends from Minneapolis to the mouth of the Missouri, 664 miles. The discharge at St. Paul varies from less than 1,000 to 130,000 sec.-ft., and above the mouth of the Missouri from 10,000 to 375,000 sec.-ft. Here the bluffs are high and not far apart. While the river has, in the ages, wandered from bluff to bluff, the wandering is slow. The banks are more permanent than below the mouth of the Missouri; the material in the bars and river bed is coarser, less subject to erosion and moves shorter distances; and the water is clearer. Compared with conditions below the Missouri, this may be said to be a clearwater stream and free from floating drift. The method of improvement (aside from four locks to overcome short sections of steep slope) is to close side channels and to so narrow the low water stream that it will, by scour, secure its project depth of 6 feet.

Some dredging is necessary, but this will be reduced as regulation progresses. The narrowing is done by building out dikes (called wing dams) from convex or straight banks, angled slightly up river from normal to the banks, until the project narrowing is attained. Bank revetment is provided to hold the opposite bank, where necessary, around the heads of islands, and at the shore ends of the wing dams to prevent their being flanked. The wing dams are built of alternate layers of brush and stone, with a wider brush mat beneath the structure, to prevent scour from overfall or around the ends. (Figs. 1, 2 and 3.) While the dams narrow the river at low water, they are low enough to allow medium and high stages to pass over them. The danger from scour is not great, in fact is so little that it has become quite the custom to make a large part of the dam from hydraulic fill along the axis, to be capped by the usual brush and stone structure, thus greatly reducing the cost, particularly when dredges are on channel dredging near enough to make it possible to deposit the discharge in the dams. The relative absence of drift and the slight tendency to scour, leave only one dangerous enemy to these dams—floating ice when the river breaks up in the spring. This sometimes shears off the upper part of a dam, or rakes off the upper layer of stone.

The first project for the Upper River was adopted in 1878. This included contraction works to provide a depth of 4½ ft., with isolated local projects for the Rock Island and Des Moines Rapids—the latter at Keokuk. There was expended on these projects $19,105,000 of which $6,996,000 was expended on the local projects mentioned. The present project—for 6 ft. depth—was adopted in 1907, at an estimated cost of $20,000,000 additional, for completion and for maintenance during construction, and $300,000 annually thereafter for maintenance. The new project involved no abandonment of work already in place—simply increased the number of dikes and their lengths. The estimate was based upon completion in twelve years, and the plan was adopted by Congress. But, as in the case of the Middle River, appropriations were not made as expected. On this new project there was expended, to include 1924, $15,440,000 for new work, and $556,000 for maintenance. No better illustration can be had of the problems involved in the two sections than the relation between the costs of maintenance of unfinished work. A re-estimate of the cost of completing the works, to fit post-war conditions, was made in 1921. The result was to raise the original estimate to $27,000,000, including maintenance during construction, but the annual cost of maintaining the completed work was left at $300,000.

Middle River—The Middle River extends from the mouth of the Missouri to the mouth of the Ohio, 200 miles. The discharge at St. Louis varies from less than 20,000 to 150,000 sec.-ft. The method of regulation is in general the same as on the Upper Mississippi—closing side channels, narrowing the river and revetting caving banks—but the treatment differs. Here the river partakes of the character of the Missouri. The bluffs are farther apart than on the Upper Mississippi; the bed and banks are more easily eroded, increasing

the wanderings of the river; the water is heavily charged with sediment; any material rise brings down large quantities of drift; and floating ice is still a menace. Thus it becomes necessary to give greater resisting power to the works of regulation. In plain language, they have to be "nailed down." Bank protection (Figs. 4 and 5) has to be of a stronger type, and contraction works (changed in name from wing dams to dikes) are made of piles driven deeply into the river bed. The project depth is increased to 8 ft., below St. Louis. Dredging becomes more of a factor in the improvement plan, in this section. But the great quantity of floating drift is not an unmixed evil. With the dikes made strong enough to stand the strain, this floating drift lodges on the upstream side and changes a very open structure into a permeable mass. As this drift accumulates, it is weighted down with stone and sunk till it reaches the foundation mat.

The simplest form of dike is constructed as follows (Fig. 6): After protecting the bank to prevent scour around the shore end of the dike, a woven-brush mat, 125 ft. wide, is run out from the bank the full length of the dike, angled slightly upstream and widened at the outer end. Through this mat, and much nearer its upstream than its downstream edge, three rows of piles are driven out from the bank, with a cross-head at the outer end. The two outside rows of piles in the dike are 9 ft. apart and the piles in these rows are 9 ft. apart, and opposite each other. The middle row is midway between the other two and its piles are midway of the spaces in the outside rows. Each pile of the middle row is bound in at the top with the two adjacent piles in the outside row (alternately upstream and downstream), thus forming two rows of 3-pile clusters, staggered and having a combined base of 9 feet. In order to transmit the thrust against the upstream row of clusters to the downstream row, thus utilizing the full resistance of both rows, a single pile is placed horizontally and longitudinally into the angle between the groups and wired in place. In deeper water a third, and sometimes a fourth, row of clusters is added.

A single flood, after drift has accumulated and been sunk, will often silt up between these dikes practically to their tops and solid, on which the succeeding summer will see a growth of willows started, leaving a permanent bank some 20 ft. above low water. The ultimate plan is to revet these new-formed banks and thus hold them to their alignment, after the dikes have rotted away. But this part of the final program has never been reached.

In 1872 the first project was adopted for the Middle River. No estimate of the total cost was made. Under this project there were expended $1,495,000 for new work. In 1881 the present project was adopted, dredging being afterwards added, in 1896. No estimate of the final cost was made. In 1910 it was estimated that the project could be completed for $21,000,000 additional, including the cost of maintenance during construction, and that the completed work could be maintained for $400,000 annually. This was based on completion in twelve years, and Congress adopted that plan. Appropriations were not kept up, and, as a result, most of the small appropriations since 1912 have been expended for maintaining existing work and for dredging. Maintenance costs are much greater where work is left in isolated stretches and subject to attack at both ends. From 1881, to include 1924, there were expended on this project $10,208,000 for new work and $9,720,000 for maintenance. At the present time estimates are being revised to meet post-war conditions.

FIG. 4—WEAVING A MATTRESS ON LAUNCHING BARGE ON MIDDLE MISSISSIPPI

Warp of poles, woof of brush. Top poles are wired to warp poles. This mattress is curved to fit around a projecting point in the river bank.

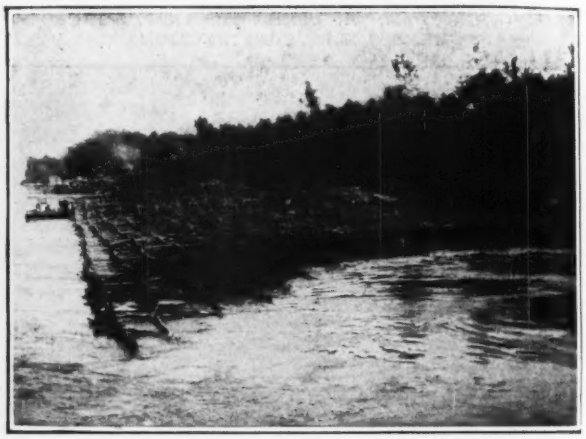


FIG. 5—MATTRESS AND CAVING BANK ON MIDDLE MISSISSIPPI

Looking down river. Mattress head was attached to mooring barge (not shown) until enough was built and sunk to form its own mooring. Construction from launching barge.

Lower River—The Lower River, from the mouth of the Ohio at Cairo to Head of Passes, is 1,060 miles long. The discharge at Columbus, Ky., varies from 71,000 to 2,015,000 sec.-ft. Here the problem of control is complicated by the added danger of flood and the regulation details are essentially different from the other two sections. The alluvial valley is wide, the bluffs on one side or the other (and sometimes on both sides) being remote from the river. The banks are higher and are composed of material finer and more easily eroded; and the tendency of the river to shift its course is greater. Bank protection is a more serious problem, calling for elaborate and expensive treatment. The river is charged with sediment; floating drift and snags are plentiful, brought down by each rise; but floating ice ceases to be a menace to improvement works.

In the early stages of its career, the Mississippi River Commission (in charge below Cairo since 1879 as noted below) undertook, in two sections of the river,

works of contraction of the various types known to the problem of river regulation, but it met with little success and many losses. It demonstrated that strict regulation could not be made generally effective within reasonable time or cost. As a result of experience, it decided to limit its works to bank revetment to hold the low-water river within bounds, and to levees to hold floods within bounds. It was early decided that a navigable low-water channel could not be maintained if floods were allowed to roam at will; and levees became a part of the river improvement plan. In this part of the river there is water enough to maintain the project depth of 9 ft. without resort to regulation, other than bank revetment, except at a limited number of bars where low water dredging has to be carried on. As bank revetment progresses, and the caving of millions of yards of earth—just so much bar-forming material—into the river is stopped, it is expected that the necessary amount of dredging will be reduced. But it is not expected that dredging can ever be entirely eliminated. Nothing but complete regulation at the wide crossings could do that, and dredging is much less expensive and much more certain than such regulation. But without bank revetment, to hold the low-water river within bounds, the project depth could not be maintained by dredging alone, at reasonable costs.

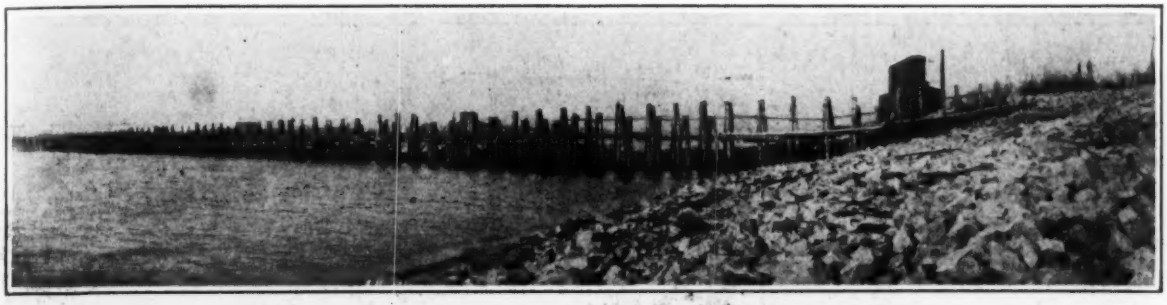


FIG. 6—PILE DIKE ON MIDDLE MISSISSIPPI IMPROVEMENT
Note the dike-head at extreme outer end, bank revetment at shore end, and accumulation of drift on upstream side of dike.

The project width of the dredged channel is 250 ft. and its depth is 9 ft. Navigation interests seem to think that there is no reason why these dimensions cannot be indefinitely increased, by providing the necessary dredges. This is a great mistake. The river is made up of pools, with very little slope, separated by crossings or bars. Several of these pools and low bars, grouped together, form a long pool between two high bars, such as need dredging to get the project depth. At these high bars the slope is much more excessive than in the pools between them. In fact they are dams between the long pools, just as decided as are the dams in a canalized stream. Before dredging there is no trouble in navigating the pools. The trouble is in getting past the high bars. This must be done by dredged cuts. Such a cut removes a part of the dam. This partial removal of a bar or dam tends to draw down the level of the pool above it. If it be drawn down too much, it will bring some of the low bars in the pool so near the surface that they will also need dredging. So it becomes a matter of determining how much removal can be safely done without danger of so drawing down the pools as to increase navigation difficulties. The commission has decided that a dredged cut 250 ft. wide and 9 ft. deep will provide for navigation and not seriously draw down the pools.

It was early appreciated that the Lower Mississippi was a problem by itself. There was practically nothing done on this part of the river prior to 1879—no project had been made. The act of June 28, 1879, provided for the organization of the Mississippi River Commission. Its jurisdiction was specified—from Cairo to Head of Passes. It was to consist of seven members, appointed and commissioned by the President, and made up as follows: "Three officers from the Engineer Corps of the Army, one of whom shall be designated by the President as president of the Commission, one representative from the Coast and Geodetic Survey, and three members from civil life, two of whom shall be civil engineers." No legislation since that time has affected its organization or duties, but some few extensions of jurisdiction have been made. Early legislation provided that the work should be done "in accordance with the plans, specifications, estimates and recommendations of the Mississippi River Commission." This gave it power beyond those applying to other river and harbor works, which are directed by the Chief of Engineers and the Secretary of War. The commission could form its own plans and carry them out, the sole limitation being the approval of the Chief of Engineers and the Secretary of War—in plain language, a veto power.

The commission formulated its policy and it was approved by Congress. Owing to the uncertain nature of the problem, no definite estimate of the cost of improvement could be made. Prior to 1917, the building of levees to confine the flood waters was simply an adjunct to river improvement. The act of March 1, 1917 (known as the Flood Control Act), made flood control as definitely a part of the commission's work as is river improvement. It provided for co-operation by local interests in levee construction—they to meet at least one-third the cost thereof—but the cost of river improvement was left entirely to federal appropriations.

Including the year 1924, the commission has expended $102,908,000 for new work and $34,290,000 for maintenance, for dredging, and for all its other activities, such as surveys of the entire river, gages and discharge measurements on the main river and tributaries—in fact the collection of all data necessary to a thorough study of the problems involved. Of the above total of $137,198,000, $59,723,000 has been expended for levees. In addition to these amounts, the commission has expended $9,363,000 contributed by local interests under the flood control act, and $2,344,000 contributed by local interests for bank protection in cases where levees were threatened and no federal funds were available for the work. It may also be stated that local

interests have expended, on their own account, from 1882 to the end of 1923, $135,440,000 in levee construction, aside from their contributions under the flood control act.

Snagging—The removal of snags on the entire river is done by two Engineer Department districts—by the Rock Island District from Minneapolis to the mouth of the Missouri, and by the St. Louis District from the mouth of the Missouri to New Orleans, including the Atchafalaya.

Comparison of Three Sections—It may be said that river regulation in the upper river is an exact science, and becomes only a question of money; that in the middle river, regulation is more precarious, although still within the bounds of reasonable costs and sure results, but is much more expensive and can only be maintained by eternal vigilance and care; while in the lower river, regulation, other than bank revetment, is not feasible. Contraction works extending beyond the banks are of too uncertain life.

A fair illustration of the complications and costs of work, in the three sections of the river, may be had from a brief description of the one feature that enters the work in all sections—bank revetment. This, in all cases, consists of an under-water brush mattress, weighted down with stone; and an upper-bank pavement of hand-placed stone—sometimes of concrete blocks or concrete *in situ*. In the upper river where the banks are low, the water shallow, and the current not strong, and where stone may be had at many points, the construction is simple and inexpensive. The mattress (20 to 40 ft. wide) is made of fascines of small brush laid parallel to the bank, with top and bottom cross poles wired together through the mattress (Fig. 1). A lap of 4 ft. in the fascine gives sufficient longitudinal tenacity to the mattress to allow of its being made continuous and sunk progressively. The upper bank paving averages about 25 ft. wide. The cost per linear foot of completed bank revetment, at present prices, is about $5. In the middle river the mattress is 125 ft. wide and is made of large brush woven (Fig. 4) so as to give it also sufficient tenacity to hold together, while being made continuous and sunk progressively (Fig. 5). The upper-bank paving, due to the increased bank height, averages about 75 ft. wide. Stone may be had without excessive haul. The total cost per linear foot of protected bank is about $25.

In the lower river the mattress is 250 to 300 ft. wide—at New Orleans it runs as much as 400 feet. The standard mat is made up of fascines of very heavy brush, 16 in. in diameter, each bound to the next, by continuous ¼-in. galvanized wire weaving strands, passing around each fascine and set up by hand winches. The strands are fastened at intervals of 10 ft., by clips, to through ½-in. galvanized wire cables (Figs. 7 and 8). Even with this great longitudinal tenacity, the sinking of a mattress has to be done with great care. The successful sinking of a 1,000-ft. mattress, without having a portion of it torn away, is generally a cause for a feeling of relief. Progressive sinking, as in the middle and upper rivers, is impossible. The mattresses therefore have to be made and sunk in sections—1,000 ft. being about the limiting length of a section. The upper bank paving of stone (or sometimes of concrete) will average about 120 ft. wide. Stone has to be hauled long distances. The total cost per linear foot of completed revetment is about $65.

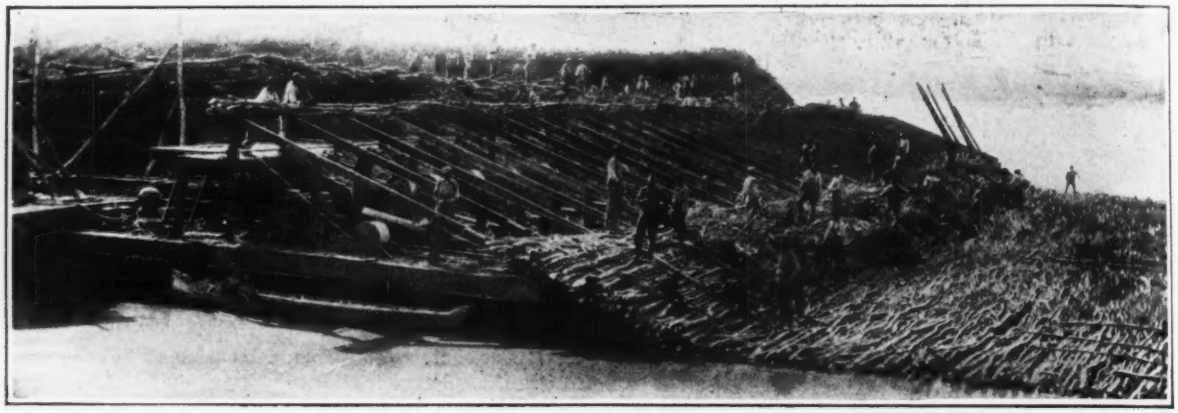


FIG. 7—BUILDING A STANDARD MATTRESS ON LOWER MISSISSIPPI

Old-fashioned hand method of handling brush. Note the fascine being formed at head of ways, hand winches on mat for setting up on ¼-in. weaving strand, and drums under the ways for paying out the through ½-in. main cables.

Flood Control

The commission's flood-control policy is to confine between levees the flood flow as nearly as possible to the bank-to-bank width of the river. This has several advantages. It protects more land from overflow; it places the levees on the highest ground, thereby reducing their cost; it prevents cross currents and consequent fill within the river banks in flood, to the detriment of the low-water channel and navigation; and in short, it helps to stabilize the river in every way, at the same time protecting the delta lands and communities. It thus combines flood control and river improvement.

When the commission (in 1882) began the construction of levees, it adopted generally the line which existed at that time. This line had been built by planters and local and state organizations. Thus the commission had, to start with, a small embankment of nearly the same length as that now under its control on the main river below Cairo. It therefore became a question of enlargement of that embankment rather than one of the progressive building of a new line. As the enlargement progressed, and the flood waters were more completely confined to the narrow space, flood heights were necessarily increased. In order to give all the people partial protection (protection from all but the greatest floods) the grade of the whole line was

increased by stepping upward. If the plan of raising certain sections to full estimated grade had been adopted, it would have given full protection to certain

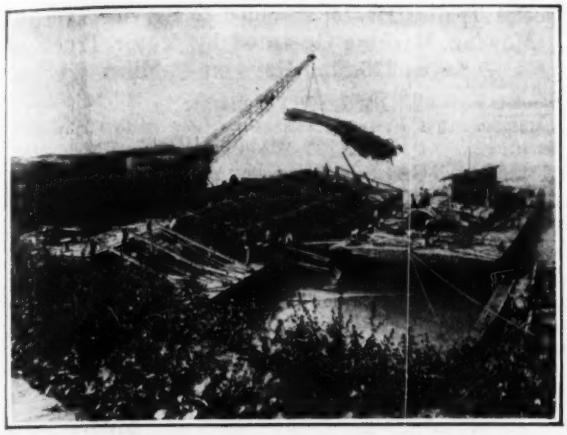


FIG. 8—STARTING NARROW MATTRESS ON LOWER MISSISSIPPI IMPROVEMENT

Modern method of handling brush. Note mat head—an immense fascine of poles—to be firmly secured to mooring barge, shown at right.

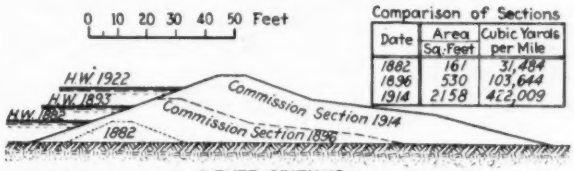
areas and would have largely destroyed (by the consequent increased flood heights) the partial protection already enjoyed by other sections.

Fig. 9 shows three steps of this progressive enlargement of the levee at Lake Providence, La., and the corresponding increase in flood height. Necessarily there were many crevasses, particularly in the earlier stages of this enlargement, but they have been fewer and fewer as the work advanced. These were caused by the overtopping of the immature levees in great floods, by bad foundations or poor construction in the original levee, or through the absence of a banquette. When a levee, with 3 to 1 side slopes, gets above a certain height, the line of saturation, sloping downward from the water line at an angle of about 12 deg. below the horizontal, will pass out of the rear slope, starting a dangerous flow, which may, particularly in poor material, cause a crevasse. To avoid this, an additional embankment (called a banquette) is added on the land side, so that the line of saturation will enter the ground under the levee, rather than come to the surface. In the early stages of the work, a banquette was considered as a luxury—the money should be put into the main embankment. Now both are necessities.

This gradual building upward toward an ultimate levee grade, thus keeping up with an increasing flood level (caused by the confinement of the floods and not by their increased volume), is believed to be responsible for the widespread fallacy that levee grades must be carried on upward, due to a consequent rise in the river bed. There is no such general rise in the river bed. The present levee grades are only what the commission foresaw, as early as 1882. Local changes in flood levels do occur, showing assumed levee grades to be too high or too low. These changes are limited in extent, both in height and length; the reasons for them can be either foreseen or traced; and the grades are changed accordingly. No such change has ever occurred of sufficient magnitude to approach the 3-ft. freeboard allowed on all levees.

There are now completed, or nearing completion 1,824 miles of levee line on the Mississippi River, containing about 429,000,000 cu.yd. of earth, and requiring about 76,000,000 cu.yd. to finish it. That would have been the end of the commission's levee building but for the fact that Congress has recently extended the commission's jurisdiction to the tributaries and outlets, in so far as they are affected by the flood waters of the Mississippi River. Thus there is put upon the commission an entirely new work, covering several hundred miles of levee, some partially built, but most of it untouched, and comprising many million cubic yards of embankment.

When commission reports are consulted, progress toward completion of the *existing* line seems slow. Likewise, when stated in cubic yards, the item "Lost or abandoned" seems large. The reason why progress toward completion appears slow is that new territory is continually being brought under commission jurisdiction, which pushes the goal further away. In 1918 the "estimated final contents" of the system was 473,000,000 cu.yd. It is now 505,000,000, although no change in grade has been made. In 1918 the estimated yardage to complete was about 131,000,000. Since then, the government and local levee boards have added 102,580,000 cu.yd., but there have been "lost or abandoned" 15,800,000 cu.yd. The goal has been pushed 32,000,000 cu.yd. ahead, and the actual approach to it has been only 86,780,000 cu.yd.—84.6 per cent of the yardage actually added. When figured on a percentage basis, the "lost or abandoned," in the past six years, has averaged only $\frac{7}{10}$ of 1 per cent per annum of the average annual "contents" of the system—not a large percentage for depreciation. The losses have been due to the necessity of adopting new lines and



Comparison of Sections

Date	Area Sq. Feet	Cubic Yards per Mile
1882	161	31,484
1896	530	103,644
1914	2158	422,009

FIG. 9—PROGRESSIVE LEVEE BUILDING AND RESULTING FLOOD LEVELS AT LAKE PROVIDENCE, LA.

abandoning old lines—to get a shorter and less expensive line, to get the levee on better ground, or to throw it farther back, where threatened by a caving bank. The caving of banks is much the greatest cause of losses. Bank revetment is the only remedy for this evil.

The new flood control act is based upon $30,000,000 United States funds, plus $15,000,000 contributed locally ($45,000,000 in all, on the basis of one-third local co-operation), for levees, and $30,000,000 for bank revetment and all other purposes. The $45,000,000 for levees was the estimated amount necessary to finish the front line levee and complete the work on the tributary levees. It was based on the best information (in the absence of tributary surveys) that could be hurriedly accumulated, when called for by Congress. More careful study (still lacking surveys) indicates that this figure may be low, but the study covers every possible area. The protection of some of these areas will never prove feasible from an economic standpoint, and some will not be undertaken until long after the life of the flood control act. Again the exact limits of the added

jurisdiction are not yet determined. It may therefore be assumed that there will be at least $30,000,000 available for bank revetment in the next six years, if the appropriations are made as expected. That will build 90 miles of revetment, which will go a long way toward protecting the levee line, and at the same time work toward river improvement, making a fair start on that long, long trail. But the river works more rapidly than the funds will be made available and some loss of levee line will occur before the banks can be revetted.

Organization of River Control

River and harbor works in general are carried on by district engineers, officers of the Corps of Engineers, U. S. Army, in charge of all works within certain geographical limits; these districts are grouped together into divisions under supervision of a division engineer—an engineer officer of higher rank; and all are under the Chief of Engineers, U. S. Army. The upper and middle river districts are under control of such officers located at St. Louis—all in the Western Division.

The commission's work is carried on by district engineers under its own direction, officers of the Corps of Engineers, U. S. Army, detailed by the Chief of Engineers for that duty, and their location and duties are:

St. Louis: All duties pertaining to general commission activities — main office management, inspection, surveys, gages, discharge measurements, etc.—and flood control from Rock Island to Cape Girardeau—450 miles.

Memphis: River improvement and flood control, Mouth of Ohio River to Mouth of White River (390 miles) with flood control to Cape Girardeau—55 miles above Cairo.

Memphis: At West Memphis is the commission's depot for maintenance of dredges, and its district engineer in charge of all dredging activities.

Vicksburg: Flood control and river improvement, Mouth of White River to Vicksburg—215 miles.

New Orleans: Flood control and river improvement, Vicksburg to Head of Passes—455 miles.

Local interests—their organizations known as Levee Boards and their territory known as Levee Districts—are organized under the various state laws, which govern their activities, fix their limits, and regulate their powers of taxation and bond issue. Some are small and some are large. No district includes territory in more than one basin and necessarily never in more than one state, and often, even in the same basin and within a single state, there are two or more districts, each confined to definite geographical limits.

Within its present flood control limits—Rock Island to Head of the Passes and up all tributaries as far as affected by the flood waters of the Mississippi—the commission has complete jurisdiction over levee construction. Beyond those limits the federal government does no levee work. Private interests are entitled to build their own levees, within or without these limits, subject only to federal control of navigation and the regimen of the river. In general, local interests within commission jurisdiction join in co-operation with the commission, but sometimes they prefer to build and maintain their own levees, meeting the entire cost, rather than to adopt commission specifications, sections and grades. When they voluntarily come under commission jurisdiction they must adopt commission standards. When they remain outside that jurisdiction, the commission does not dictate to them, beyond the general federal jurisdiction over waterways as cited above.

Improved Methods Cut Upkeep Costs of Concrete Roads

Special Trailer Heater Coupled to Service Truck—Mowing Machine Operated by Motor Truck Saves 226 Man-Days on 38 Miles

By H. J. Friedman
Maintenance Engineer, Savannah Division State Highway Department, Savannah, Ga.

THE ANNUAL allotment per mile for maintaining the state system of roads in Georgia has been approximately $200. By law it is required that the funds for maintenance be spent within each county on the basis of its pro-rata mileage of state road. This, in most counties, compels practically the same expenditure per mile whether a road is surfaced with concrete, asphalt, gravel, sand-clay, or whether it is unsurfaced. Due to favorable climatic conditions this allotment is sufficient for the maintenance of concrete pavement. The stretches of concrete pavement are, however, usually isolated and their mileages are seldom large enough to require the entire time of a patrolman and his crew. Consequently a crew is assigned a certain mileage of concrete road and in addition is required to keep up a considerable mileage of sand-clay or similar surfaced road. As the lower type of road requires the greater amount of attention, an effort was made to reduce, through improvements in methods, the amount of time put in on the upkeep of the concrete roads.

The methods described have been put into effect on maintenance section 1 of the Savannah Division. This section consists of 38 miles of concrete pavement in Chatham County and 20 miles of sand-clay road in two adjoining counties. Before the highway department took over for maintenance the entire state system on Jan. 1, 1922, it had been maintaining, as completed federal aid projects, 18 of the 38 miles of concrete pavement in Chatham County. This work was done by a crew consisting of a patrolman and three men. On Jan. 1, 1922, with a crew increased to a patrolman and four men, the mileage to be maintained was increased from 18 to 58 miles. To handle this larger mileage satisfactorily it was evident that changes in method were necessary.

Pouring Joints and Patching Surface—Much time had been consumed in repouring expansion joints and patching the surface with bituminous material. It was found that with a crew of five men and the usual tar kettle, only two miles of surface could be put in shape per day and that it was necessary to go over the pavement in this manner three times a year. In other words, 57 working days per year for the entire five-man crew would be consumed in patching joints and surface. A study of this method developed that the men were compelled to lose a great deal of time waiting for the patching material to become properly heated. It took about a half hour in the morning after arriving on the job to get the material hot, and during the day there were frequent delays due to moving the kettle and waiting for material to become melted. With a view to cutting down these delays, a special heater, Fig. 1, was constructed.

A tank of half-barrel capacity was built horizontally over a fire-box. A baffle plate was built inside the tank to prevent the material from splashing when the heater was in motion. Both tank and fire-box were made of sheet steel, the fire-box being lined with asbestos and

carefully planned to deliver the maximum of heat to the tank. For placing the material in the tank, a sleeve-like top was designed which was easily removed but still kept moisture and dirt out of the tank, and prevented the heated material from splashing out. A spigot for drawing the melted material was placed at the opposite and lower end. The baffle plate was so placed as to prevent the unmelted lumps of material from clogging at the spigot. Heat was supplied by two kerosene air pressure burners. The heater was mounted on a pneumatic-tired, two-wheel trailer. The trailer was made with a special hitch to fasten rigidly to the rear of the truck but at the same time permit rapid uncoupling in such a manner that the trailer would automatically stand without tilting after being detached from the truck. This was considered necessary in case of fire. As a further safeguard against fire an extinguisher was provided for the truck.

Before beginning the work of pouring, the patrolman and crew place sand piles at intervals along the road for sprinkling on the melted material immediately after it is poured.

For the work of pouring, a crew of five men, including the foreman, is used. The equipment consists of a one-ton truck and the heater mounted on the trailer. On the truck are carried two barrels of patching material, a sand bin, and necessary small tools. The sand bin is replenished from the sand piles previously placed.

Before leaving headquarters in the morning, the tank on the heater is filled one-third full with patching material and the burners are lighted. By the time the work is reached, the patching material is melted and there is no delay in getting to work. One laborer is stationed

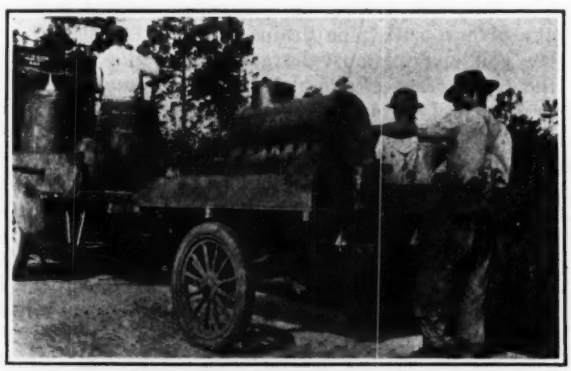


FIG. 1—TRAILER, HEATER AND TENDER TRUCK

with the heater, keeping the burners properly adjusted and filling the tank with cold material as required. The second man goes ahead cleaning joints and cracks with a broom and a pointed bar. The third handles the pouring, drawing the melted material from the heater, and the fourth follows close behind, sanding the poured joints and patches. The patrolman drives the truck forward to its proper location and keeps the job moving, assisting any man who falls behind.

With this line-up every man has but one duty to perform and as the heater delivers an adequate supply of melted material at all times, the crew is kept constantly on the move. The average day's work with this layout is six to eight miles of joints, cracks, and patches poured (joints being 50 ft. apart and pavement 16 ft. wide), against an average of two miles under the old method. Further, as the material is supplied at a uniformly higher heat, better adhesion to the pavement is secured.

The saving over a year's operation is the difference between 57 working days with the old type of kettle

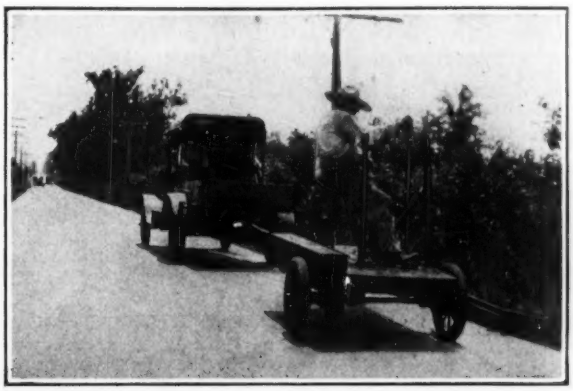


FIG. 2—MOWING MACHINE PULLED BY TRUCK

and 19 with the new heater, or 38 days. The cost of running the crew being $20 per day, $760 per year is saved.

Shoulders—Maintenance of the earth shoulders was the other phase of the work in which improvements in method were sought. A great deal of time had been spent in keeping the growth of vegetation down by mowing. On 38 miles of concrete road there are, of course, 76 miles of shoulders. The usual farm mower pulled by a team will cut an average of 10 miles of shoulders per day. This small mileage is largely due to the amount of time consumed in getting to and from work. A trip over all the shoulders consumed 8 working days. During the growing season, from May 1 to Oct. 1, it is necessary to mow shoulders once a month, or six times during the year. This means 48 working days for a man and team per year. At $8 per day (the cost of man, team, and operation of the mower), the cost per year is $384. The real loss, however, is in the disrupting of the organization of the maintenance crew by keeping one of the force away from his regular duties for 48 days per year.

After an investigation, it was found that there were a number of mowers that could be attached to a small tractor, but for our purpose these had no particular advantage over the horse-drawn mower, except that the outfit could be left out at night, and by going to and from work with a truck some time could be saved.

A mower was finally found that could be pulled by truck power. This unit, Fig. 2, has proved most satisfactory. It has rubber tires and is designed for highway work. Behind a one-ton truck it operates at an average speed of 7 miles per hour, or 50 miles per day. One man is required to drive the truck and one to operate the mower. Due to the high speed at which the mower operates, it is capable of cutting heavy growths that would choke the ordinary mower. The shoulders on 38 miles of road can easily be mowed in two days. For the six cuttings per year, 12 days are required. At $10 per day, the cost of two men's time and the operation of the truck and mower, the cost for the year is but $120 against $384 when using a team-drawn mower. The saving in time, 12 days against 48 days, is more important than the money saving. Further, a better job is done with the truck-drawn mower.

The other phase of shoulder maintenance was preventing erosion and keeping the shoulders properly built up. By encouraging a growth of sod through planting and by keeping down the weed growth by mowing, the problem of washed shoulders was practically eliminated. A growth of grass has been developed also, through the cut ditches and on the slopes of cuts. This has practically stopped erosion and the consequent either washing out or filling up of cut ditches. Except in a few scattered instances, it has not been necessary to do any work in cleaning out cut ditches. In no case has it been necessary to operate a road grader for this purpose, the little work needed being done by hand shoveling.

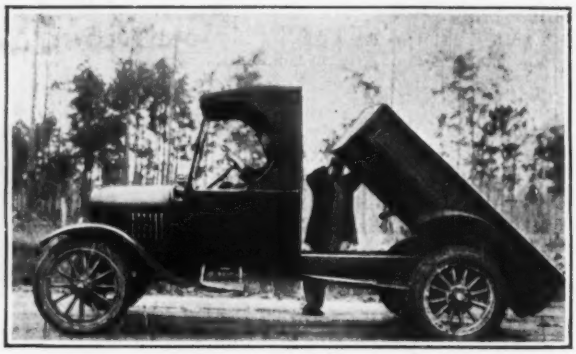


FIG. 3—FIXED BODY CONVERTED TO DUMP BODY

There has of course been settlement on the shoulders and also wear due to the traffic of horse-drawn vehicles which have a weakness for traveling with one wheel off the pavement. To restore these shoulders to their proper grade requires a selected class of borrow material which it is necessary to haul by trucks from pits usually at some distance. The standard maintenance truck is the one-ton Ford. This comes equipped with a stationary steel body. As considerable time was lost in shoveling the material from the truck, the stationary body was converted into a hand dump body, Fig. 3. It was raised 3 in. off the chassis by means of wooden strips and moved back 2 in. to secure proper balance and freedom for dumping. The body was fastened and pivoted on a ½-in. rod placed horizontally over the rear springs and upon the wooden strips fastened to the chassis. This made the body a gravity dump type that could be handled by one man. The front end was fastened down by a latch and, in dumping, the body was held in control by a spring and chain. The cost of this conversion was between $8 and $10 and for general maintenance the body serves equally well as a stationary or dump body.

Conclusion—By these improved methods the estimated savings in time and money have been:

	Amount	Man-days
Patching surface	$760	190
Mowing shoulders	264	36
	$1,024	226

The savings on shoulder maintenance, due to the conversion of the truck body from stationary to dump have not been included as it is difficult to arrive at any figure.

While the above saving appears comparatively small in the aggregate, it amounts to $27 per mile per year. It has permitted the accumulation of a surplus which is used for bridge repairs for which it would otherwise have been necessary to request an emergency allotment.

The saving in time of 226 man-days or 45 working days for the entire crew has the effect of giving additional attention to the maintenance of the eighteen miles of sand-clay road, where it was badly needed.

Continuous Three-Span Concrete Railway Bridge

Triple-Girder Through Spans Built as 150-Ft. Monolithic Structure—Wood Stringers on Floor Carry Track Rails

ONE OF THE LONGEST reinforced-concrete railway bridges of the through-girder type which has been built is a triple-girder continuous three-span bridge built in 1924 to carry the Cincinnati rapid-transit line over Reading Road. This bridge, shown in Fig. 2, has a central span of 70½ ft. over the roadway and sidewalks and two side spans of 40½ ft. As it is on a skew of 51 deg. 23 min., the length of span measured on the square is 55 ft. for the central and 34 ft. for the side spans. The girders and deck slab are continuous over the four supports. This type of structure was selected on account of its shallow floor system, giving the required 15 ft. head room over the street without raising the grade of the railroad.

Three girders 9½ ft. deep have the rectangular bottom chords connected by floorbeams, between which are longitudinal stringers located directly under the rails, as shown in Fig. 1. Upon this floor framing is the 6-in. deck slab, having its top surface formed in drainage planes, with pipe drains through the slab at the low points. An unusual track construction is adopted, the top surface of the slab having recesses 1 in. deep to receive four 6x12-in. creosoted stringers to which the 85-lb. T-rails will be fastened by screw spikes. Tieplates will be placed on each stringer and tierods through the webs of the rails will provide for maintaining and adjusting the gage. The stringers are secured in place by ¾-in. bolts and inserts in the floor. A finishing coat 1:2 cement grout is given to the floor. On the exposed face of the structure a coat of cement paint was applied, but it is proposed to give a light surfacing later with a cement gun.

In the design, the live-load was assumed as a 70-ton electric car on each track, with 50 per cent allowance for impact, while the dead-load was taken at 150 lb. per cubic foot of reinforced-concrete. The assumed stresses were 18,000 lb. per square inch for steel, rail

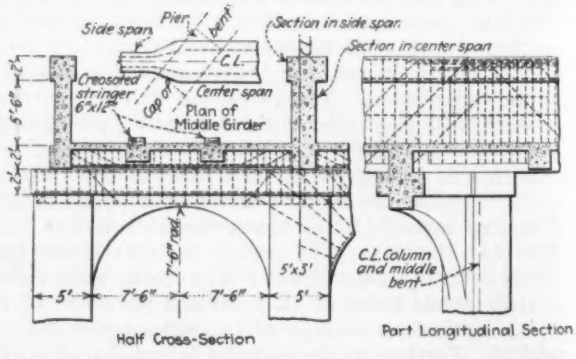


FIG. 1—THROUGH GIRDER CONCRETE RAILWAY BRIDGE

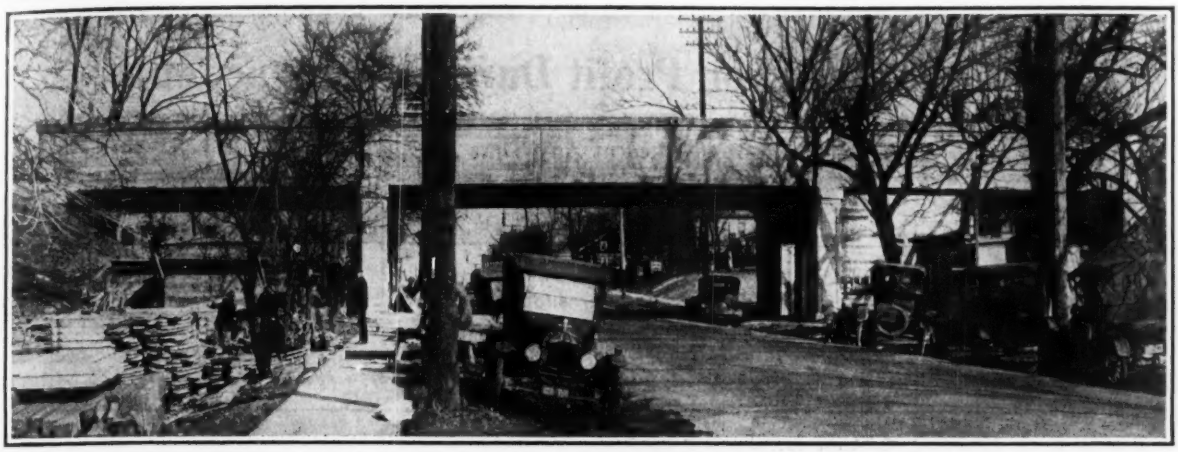


FIG. 2—CONCRETE CONTINUOUS-GIRDER BRIDGE AT CINCINNATI, OHIO

steel reinforcement being used, 700 and 150 lb. for concrete in compression and shear respectively, and 6,000 lb. per equare foot for earth bearing at foundations. The floorbeams and deck slab were assumed to be fixed at both ends; the end girder spans fixed at one end and the central girder span simply supported at the ends.

In the continuous side girders, a uniform section is maintained for the chords and webs throughout the entire length. But in the central girder, the thickness of chords and web is increased for the longer middle span, as shown in Fig. 1. The abutment piers and center pier are three-column bents with arched openings in the curtain walls below the caps; the abutments are embedded in the approach fills, the slopes of which extend to the parkways along the sidewalks, the central span extending over the sidewalks.

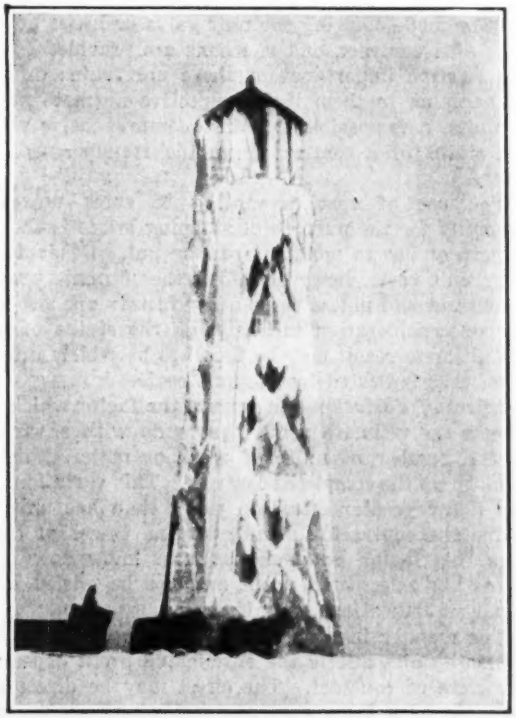
This bridge was designed by J. R. Biedinger and built under the direction of Frank L. Raschig, assistant chief engineer of the Cincinnati Rapid Transit Commission; F. S. Krug is chief engineer. The general contractors are Hickey Brothers, Columbus, Ohio, but the Reading Road bridge was built by J. W. & W. C. Martin, Indianapolis, Ind.

Baltimore Emergency Zoning Ordinance

To meet the emergency created by the decision adverse to zoning in the city of Baltimore, noted in our issue of Feb. 26, p. 367, there was passed within a few days an ordinance designed particularly to protect some of the old residence districts until a more comprehensive ordinance could be drawn. The ordinance recites the necessity for regulating the use of land, buildings and structures in Baltimore "with a view to safeguard the public welfare, security, health and morals." It then prohibits the erection of any building which, because of its particular location or prospective use, "would in any way menace the public health, public welfare, security, health or morals." To make these provisions reasonably effective, the ordinance provides for applications to the zoning commissioner for building permits, public hearings, appeals to the Board of Zoning Appeals, and to the City Court. Buildings for strictly residential purposes are exempted from all provisions of the ordinance. Jefferson C. Grinnalds is secretary of the Board of Zoning Appeals.

Heavy Ice Load on a Tank Tower

ABNORMAL loading of a steel structure is illustrated in the adjoining view, from the December issue of *Factory Mutual Record*. In presenting the picture, C. D. Abbott, assistant engineer of the Associated Factory Mutual Fire Insurance Cos., points out that tank towers are not designed to carry such an immense burden of ice, "which in several instances has caused complete collapse." Such ice loading will not occur if a tank is never overflowed to prevent freezing and if leakage is prevented. A tank heating system will protect the tank against the danger of an ice plug forming at the top or in the pipe. Such ice plugs have repeatedly caused the destruction of a tank by vacuum or pressure action resulting from draft of water or pumping, or by fall of a mass of ice after a tank was emptied.



TANK TOWER HEAVILY LOADED WITH ICE FROM OVERFLOW

Checking Up on Profit During Construction

Method Allows for Effect of Variation of Work and Materials—Actual Example Worked Through—Probable Profit Checked at Any Time During Operation

By Beardsley Lawrence
Engineer T. Stuart & Son Co., Newton, Mass.

This is the third, and last, of a group of three articles about the organization and accounting procedure of large construction companies. "How We Organize and Plan Big Building Operations" was discussed by L. J. Horowitz, president, Thompson-Starrett Co., New York, in "Engineering News-Record," March 12, p. 428; and "How to Keep Costs on Construction Work," by A. L. Hartridge, construction manager, Stone & Webster, Boston, Mass., March 19, p. 479.—Editor.

IT HAS been demonstrated that construction cost accounting delivers its greatest value when utilized to bring forcibly to the attention of the management any material divergence between actual and estimated unit costs. In order that the facts disclosed by this function of cost accounting may be used to check losses before they have accumulated to dangerous proportions it is necessary that a tabulation of unit cost be made at frequent intervals with a minimum lapse of time between performance and tabulation.

If this tabulation of actual and estimated unit costs is prepared in such a manner that a direct comparison may be made showing the unit gains or losses of every item of a contract, and if means are provided to show the relative importance of these unit gains or losses by applying to them their respective ultimate number of units, it is possible to gain a comprehensive view of the status of a contract from the standpoint of unit costs.

The use of cost accounting to show unit costs promptly for the purpose of stopping losses is the most important use to which it can be put. Other factors than unit costs, however, affect the ultimate profit of a contract and unless these other factors are also given proper consideration in analyzing the status of a job the ultimate result may be found to be widely different from that indicated by the unit costs.

Effect of Variation—In general the factor which most affects the ultimate profit has to do with a variation in the number of units of work or material that go to make up the completed contract. This variation often has a far greater effect on profit than has unit cost. While the contractor usually has no power of control over this factor he should at least know how it will affect his anticipated profit and not be misled by the apparent indications of unit costs.

The manner in which a variation in the quantity of ultimate units affects the anticipated profit depends on the class of contract. The effect may be direct as in the case of a lump sum contract where an uncertain item such as foundation masonry varies in quantity from that estimated, or it may be indirect as in the case of a unit price contract where some item carrying a loading of overhead, or more properly speaking, "job expense," is changed in amount.

During the progress of a contract of any magnitude where various conditions are constantly occurring to cause increases or decreases in the ultimate quantities of the construction units it becomes a very complicated process to arrive at a comprehensive understanding of the financial condition at any particular time unless a method is designed to evaluate the combination of effects due to simultaneous variations in unit costs and changes in quantities. The principle used in finding the status of a job by such a method is extremely simple, and consists of a calculation of probable income and probable cost, the difference being probable profit. This calculation involves a knowledge of ultimate quantities, contract prices and unit costs, the degree of error of course depending upon the accuracy of the knowledge of ultimate units and unit costs. It is necessary to assume, until better information is obtained, that final quantities and unit costs will be as originally estimated. At the beginning of a job the anticipated profit and the probable profit agree. As the work progresses the knowledge of final quantities and final unit costs increases in accuracy, and the successive calculations of probable profit approach nearer and nearer to the truth.

TABLE I—ANALYSIS OF ESTIMATED COST

Units	Items	Estimated Unit Cost Oper.	Other	Total	Estimated Cost Oper.	Other	Total
	Job Expense						
40	Days plant rental	.....	$20.00	$20.00	.....	$800	$800
20	Tons fuel	$0.50	7.50	8.00	$10	150	160
	Materials						
1,000	Bbl. cement	.20	3.00	3.20	200	3,000	3,200
1,000	Cu.yd. gravel	.15	2.50	2.65	150	2,500	2,650
500	Cu.yd. sand	.15	2.00	2.15	75	1,000	1,075
12	M.ft. b.m. form lumber	2.00	50.00	52.00	24	600	624
5	M.ft. b.m. misc. plank for runways, etc	2.00	45.00	47.00	10	225	235
	Construction Items						
750	Cu.yd. earth excavation	.80	.....	.80	600	.....	600
1,000	Cu.yd. mixing and placing concrete	2.00	.....	2.00	2,000	.....	2,000
4,000	Sq.ft. building form panels	.10	.01	.11	400	40	440
20,000	Sq.ft. erecting form panels	.15	.01	.16	3,000	200	3,200
20,000	Sq.ft. stripping forms	.05	.....	.05	1,000	.....	1,000
8,000	Sq.ft. rubbing surface	.10	.....	.10	800	.....	800
	Estimated operating cost				$8,269		
	Estimated other cost					$8,515	
	Estimated total cost						$16,784
	Anticipated profit						2,516
	Estimated total contract						$19,300

Unit Costs—Upon the method used in tabulating the cost data depends in a large measure the value of the resulting information and the promptness with which it can be presented in useful form to the management. Provision should be made for the preparation of a report at frequent intervals which will bring out clearly the actual unit costs of what we may call the "operating" factor, that is the unit cost of labor, teams and trucks. This "operating" unit cost is the factor that is most sensitive to good or poor management in the field and consequently should receive the most frequent attention. At less frequent intervals a similar unit cost report of "other" factors should be made. The "other"

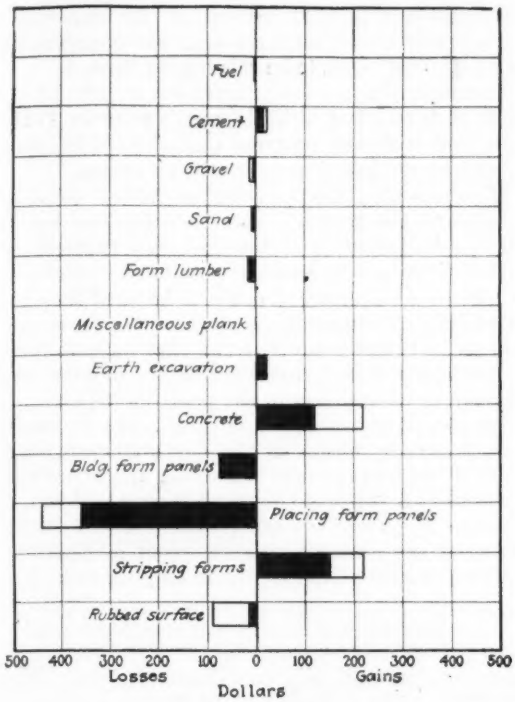


FIG. 1—CHART OF OPERATING GAINS OR LOSSES
This chart is an adaptation of one originated by Morton C. Tuttle Co., Boston, Mass., and called by them a cost tendency chart.

unit cost is not ordinarily sensitive to field management, being largely determined by the degree of business acumen exercised in the purchase of materials. These two reports of "operating" and "other" unit costs show all facts necessary to a knowledge of gains or losses due to a variation between estimated and actual unit cost. If consideration is now given to the effect due to variation between estimated and actual quantities of work to be done, a prediction can be made of the probable ultimate outcome within the limits of accuracy imposed by the possibilities of unforeseen eventualities.

Subdivision of Unit Costs—The whole structure of construction cost accounting rests upon a proper subdivision of unit quantities. Neither the division into items represented by the engineers' estimate of quantities or the usual form of contractors' cost estimate is sufficiently subdivided to serve as a basis for cost accounts. In making an analysis of construction items for cost purposes no attempt should be made to follow the bidding items. One requirement only should be kept in mind, namely, that items of cost be reduced to their simplest factors. This means that items should be subdivided to the point where they can be represented by a single kind of unit. For example take an item represented in the bidding sheet by one cubic yard of concrete. If an attempt were made to keep costs on this item without further subdivision, using the cubic yard as a unit, endless confusion would quickly result. A complete subdivision of this item would be as follows, separating the operating cost from the other cost, the operating cost on materials representing such cost as the unloading into storage piles:

Item	Unit	Kind of Cost
Cement	bbl.	operating—other
Coarse aggregate	ton	operating—other
Fine aggregate	ton	operating—other
Water	gal.	other
Form lumber	ft.BM	operating—other
Nails	lb.	other
Wire	lb.	other
Form oil	gal.	other
Mixing and placing	cu.yd.	operating
Building form panels	sq.ft.	operating
Placing forms	sq.ft.	operating
Removing forms	sq.ft.	operating
Surface finish	sq.ft.	operating

It is obvious that a subdivision into prime factors enables unit costs to be kept that are readily compared unit for unit with the estimated costs.

In order to arrive at a statement showing the condition of a contract with a minimum amount of clerical work, it is advisable to proceed by the following steps:

(a) Prepare an itemized statement of theoretical ultimate cost, using the latest available information as to ultimate unit quantities and the original estimated unit costs.

(b) Prepare an itemized statement of probable ultimate income using the latest available information as to ultimate unit quantities and the contract unit prices.

(c) Subtract the total of (a) from the total of (b). This is the theoretical profit, or the profit that would be obtained providing the estimated unit costs were exactly met.

(d) Prepare a statement of probable ultimate gain or loss due to a variation between estimated and actual unit costs.

(e) Take the algebraic sum of (c) and (d), which sum represents the probable ultimate profit.

(f) Calculate by a method shown later the percentage of completion of the contract.

(g) Apply the percentage of completion to (e) (probable ultimate profit) and obtain actual profit to date.

The probable ultimate profit obtained above is merely the difference between the probable ultimate income and the probable ultimate cost. The reason for introducing the intermediate steps to arrive at the result is for the purpose of saving clerical labor. It will be noted that statements (a) and (b) remain the same except as there is a known change in ultimate quantities. Statement (d), or the portion of it relating to operating unit cost, is the tabulation made at frequent intervals for the purpose of keeping watch on unit cost. Its use in connection with statements (a) and (b) is an economy of clerical labor. Another advantage in using this method is that statement (c) compared with previous and subsequent statements indicates the effect of changed ultimate quantities on ultimate profit without confusing the result with the effect due to variations in unit cost.

TABLE II—WORK DONE, TOTAL COST AND UNIT COSTS TO DATE

Units Done	Items	Cost to Date			Unit Cost to Date	
		Oper.	Other	Total	Oper.	Other
25	Days plant rental	.....	$500 00	$500 00	.....	$20 00
15	Tons fuel	$9 00	112 50	121 50	$0 60	7 50
700	Bbl. cement	126 00	2,100 00	2,226 00	.18	3 00
650	Cu.yd. gravel	104 00	1,625 00	1,729 00	.16	2 50
320	Cu.yd. sand	51 20	640 00	691 20	.16	2 00
14	M.ft. b.m. form lumber	42 00	672 00	714 00	3 00	48 00
6	M.ft. b.m. misc. plank	12 00	270 00	282 00	2 00	45 00
650	Cu.yd. earth excavation	500 50	.....	500 50	.77	.....
600	Cu.yd. mixing and placing concrete	1,080 00	.....	1,080 00	1 80	.....
3,800	Sq.ft. building form panels	456 00	19 00	475 00	.12	005
18,000	Sq.ft. erecting form panels	3,060 00	108 00	3,168 00	.17	.006
12,000	Sq.ft. stripping forms	600 00	.....	600 00	.04	.....
1,500	Sq.ft. rubbed surface	165 00	.....	165 00	.11	.....
	Total operating cost to date	$6,205 70				
	Total other cost to date		$6,046 50			
	Total cost to date			$12,252 20		

TABLE III—ULTIMATE QUANTITIES AT ESTIMATED UNIT COSTS (THEORETICAL COST)

Units	Items	Unit Costs Oper.	Unit Costs Other	Costs Oper.	Costs Other
38	Days plant rental		$20.00		$760.00
21	Tons fuel	$0.50	7.50	$10.50	157.50
1,100	Bbl. cement	.20	3.00	220.00	3,300.00
1,100	Cu.yd. gravel	.15	2.50	165.00	2,750.00
550	Cu.yd. sand	.15	2.00	82.50	1,100.00
14	M.ft. b.m. form lumber	2.00	50.00	28.00	700.00
6	M.ft. b.m. misc. plank	2.00	45.00	12.00	270.00
700	Cu.yd. earth excavation	.80		560.00	
1,103	Cu.yd. concrete	2.00		2,200.00	
3,800	Sq.ft. form panels	.10	.01	380.00	38.00
22,000	Sq.ft. erecting form panels	.15	.01	3,300.00	220.00
22,000	Sq.ft. stripping forms	.05		1,100.00	
9,000	Sq.ft. rubbed surface	.10		900.00	
	Total theoretical operating cost			$8,958.00	
	Total theoretical other cost				$9,295.50
	Total theoretical cost			$18,253.50	

Example Worked Through—As the best means of making clear the use of the foregoing method we will assume a hypothetical case of a contract, starting with the estimate of cost and carrying it through to a point where it is desired to learn the true profit at that time and what can then be anticipated of the final outcome.

For the sake of simplicity we will consider a contract for the construction of a concrete retaining wall involving but two bidding items, earth excavation and concrete. We will assume that bids are asked for on the basis of the engineers' estimate as follows:

Item I— 750 cu.yd. earth excavation.

Item II—1,000 cu.yd. concrete masonry.

Without considering the details at this time of how the estimate of cost is prepared we will assume that the contract is secured with a bid of $1.20 per cu.yd. for earth excavation and $18.40 per cu.yd. for concrete masonry. The bid prices are made up from the unit costs as follows:

	Est. Unit Cost	Unit Job Exp.	Unit Profit	Unit Bid	Total Bid
750 cu.yd. excavation	$0.80	$0.20	$0.20	$1.20	$900
1,000 cu.yd. concrete	15.22	.81	2.37	18.40	18,400
					$19,300

The first step in anticipation of cost finding is the preparation of an analysis of estimated cost, reducing each item to its simplest factor. Table I represents this analysis. Note that the unit cost of each item is divided into "operating" and "other" unit cost, also that subdivision is carried to a degree where each item is represented by a single kind of unit with two exceptions—"building form panels" and "placing forms." In these two items the cost of nails, wire, etc., is taken with the square foot of panel as the unit instead of providing an item of nails or wire under the material classification.

By treating each kind of material as an item of the contract in the same manner that every other item is treated there is no necessity of taking an inventory of material in order to find the status of a job. If we consider that a unit of work done, in the case of material, consists of purchasing and unloading that unit it is obvious that it makes no difference whether there is much or little material on hand; the job receives credit toward completion for every unit unloaded.

Assume now that a period of 25 days has elapsed and it is desired to know the financial state of the job. An examination of the cost records at this time will show the units of work that have been performed and their respective unit costs to be as given in Table II.

The next step is the preparation of the (a) statement of theoretical ultimate cost, shown in Table III. Note that it is now apparent that some of the ultimate quantities will not be as originally estimated.

By correcting the original engineers' estimate on account of the known change in quantities we obtain the (b) statement of ultimate income, Table IV.

The difference between the totals of Tables III and IV shows the theoretical profit to be $21,080 — $18,253 or $2,827. A comparison between this figure and the original anticipated profit shows that without reference to variations in unit cost, the changes in quantity have resulted in an addition to the profit of $311.

Investigating the effect on profit due to variations in unit cost by means of the (d) statement shown in Table V we find that the net result of the various differences is a net loss (in round figures) of $21. Subtracting this from the theoretical profit of $2,827, we arrive at the probable ultimate profit of $2,806.

The accuracy of this result is only dependent on the accuracy of the estimated ultimate quantities and the effect of future variations in unit costs.

TABLE IV—PROBABLE ULTIMATE INCOME

Units	Items	Unit Bid	Total
700	Cu.yd. earth excavation	$1.20	$840
1,100	Cu.yd. concrete	$18.40	20,240
	Probable total		$21,080

TABLE V—PROBABLE ULTIMATE GAIN OR LOSS

Items	Ultimate Units	Estimated Unit Cost Oper.	Estimated Unit Cost Other	Actual Unit Cost Oper.	Actual Unit Cost Other	Unit Gain or Loss Oper.	Unit Gain or Loss Other	Gain or Loss Oper.	Gain or Loss Other
Plant rental	38		$20.00		$20.00				
Fuel	21	$0.50	7.50	$0.60	7.50	$0.10*		$2.10*	
Cement	1,100	.20	3.00	.18	3.00	.02		22.00	
Gravel	1,100	.15	2.50	.16	2.50	.01*		11.00*	
Sand	550	.15	2.00	.16	2.00	.01*		5.50*	
Form lumber	14	2.00	50.00	3.00	48.00	1.00*	2.00	14.00*	$28
Misc. plank	6	2.00	45.00	2.00	45.00				
Earth excavation	700	.80		.77		.03		21.00	
Concrete	1,100	2.00		1.80		.20		220.00	
Bldg. form panels	3,800	.10	.01	.12	.005	.02*	.005	76.00*	19
Erecting form panels	22,000	.15	.01	.17	.006	.02*	.004	440.00*	88
Stripping forms	22,000	.05		.04		.01		220.00	
Rubbed surface	9,000	.10		.11		.01*		90.00*	
Ultimate operating loss								$155.60*	
Ultimate other gain									$135
Ultimate net loss								$20.60*	

Note: Losses are shown by an asterisk, thus: $76.00*; all other amounts in the gain or loss columns are gains.

A chart of the general form shown in Fig. 1 is valuable in connection with the data given in Table V as it enables the eye to take in at a glance the variations from estimated unit cost. Losses are shown by the bars extending to the left of the central line and gains to the right. Where there is no variation from estimated cost no bar occurs. The black portion of the bar shows gains or losses that have occurred and the total length of bar shows the ultimate gains or losses if unit costs continue the same. This chart can be readily made at frequent intervals by using the data on Table VII, which is explained later.

In analyzing the "to date" status of the contract there is no advantage in attempting to divide the costs so as to find an actual gain or loss to date. A far simpler and more logical method is to compute the percentage of work completed and apply this percentage to the probable ultimate profit. It is possible to compute the variation from estimated costs to date by using the quantities done to date instead of ultimate quantities. We are then confronted with the problem of what proportion of the theoretical profit we are justified in assuming has been earned. If it is logical to assume

TABLE VI—PLACING FORM PANELS (UNIT: SQ.FT.)

(A) Details of Estimated Unit Cost		(B) Estimated Ultimate Quantities at Estimated Unit Cost					(C) Gain or Loss Compared to Estimated Cost						(D) Cost and Unit Costs to Date							
		Date	Estim. Ultim. Units	Estimated Unit Cost Oper.	Other	Estim. Cost Oper.	Other	Date	Diff. Bet. Est. and Actual Unit Cost Oper.	Other	Gain or Loss To Date Oper.	Other	Gain or Loss Ultimate Oper.	Other	Date	Units Done to Date	Oper. Cost	Oper. Unit Cost	Other Cost	Other Unit Cost	Total Cost	Total Unit Cost
Labor	$0.15	6/1	20,000	$0.15	$0.01	$3,000	$200	6/30	$0.02	$0.004	$360	$72	$440	$88	6/30	18,000	$3060	$0.17	$108	$0.006	$3168	$0.176
Nails and wire	.01	6/10	22,000	.15	.01	3,300	220															
	.16																					

that we have earned that part of the theoretical profit in proportion to the percentage of work done it is equally logical to apply this percentage of completion to the ultimate probable profit.

The simplest method of computing percentage of completion, a method that is strictly accurate within the limits of the measured quantities is as follows:

Operating Progress

$$= \frac{\textit{Operating cost to date}}{\textit{Theoretical oper. cost} + \textit{ultimate oper. loss} \text{ or } - \textit{ultimate oper. gain}}$$

$$= \frac{6205.70}{8958 + 155.60} = 68.09 \textit{ per cent}$$

Total Progress

$$= \frac{\textit{Total cost to date}}{\textit{Theoretical total cost} + \textit{ultimate loss} \text{ or } - \textit{ultimate gain}}$$

$$= \frac{12252.20}{18253.50 + 20.60} = 67.04 \textit{ per cent}$$

A graphical chart, Fig. 2, makes for easy visualization of progress.

Another percentage that is of interest is the ratio of income allowed by the engineers' estimate to the ultimate income.

The engineers' estimate in our illustrative example for work completed to date, if figured by the customary method of allowing payment only for units completed, would be as follows:

650 cu.yd. excavation @$1.20	$780
600 c .yd. concrete @18.40	11,040
	$11,820

Dividing this total by the ultimate income of $21,080 gives 56.1 per cent. This percentage plotted on the chart indicates graphically the difference between the actual earnings of the contract and the amount allowed by the engineers' estimate.

The operating progress is of value as an index of the speed with which the work is carried on. The total progress, however, is a more correct index of the earnings of the job to date. Taking the ultimate probable profit as $2,806, 68.9 per cent of it gives a profit to date of $1,933.

Investigating the cash standing of the job we find that there has been spent $432 more than has been earned by the engineers' estimates. This is a difference of $2,365 between what actually has been earned to date and what has been earned according to engineers'

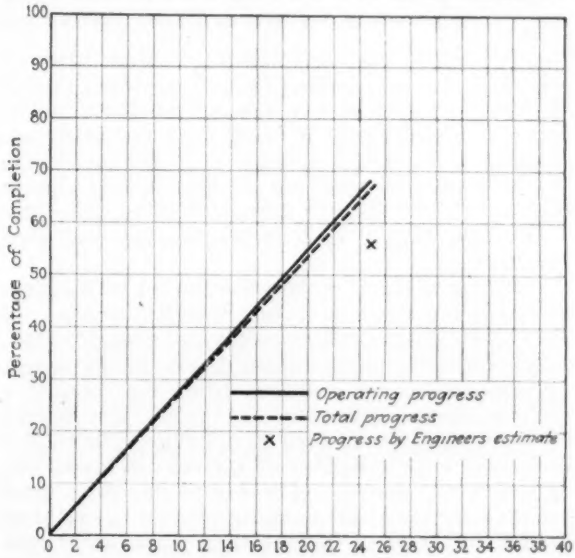


FIG. 2—CHART SHOWING PROGRESS

estimates. This is a good indication of the fallacy of attempting to gain a knowledge of the profit of a contract before completion by a comparison of cost and income.

Checking Up During Construction—In order to simplify the clerical work of cost accounting a sheet of the general type shown in Table VI, is of value. If these sheets are made up in loose-leaf form one sheet can be prepared for each item and the sheets for the whole job bound together in one binder.

Sec. *A* of this sheet is for the purpose of showing all necessary detail of the estimated unit cost of that item.

Sec. *B* shows the estimated unit quantities at esti-

TABLE VII—OPERATING GAINS OR LOSSES TO DATE AND ULTIMATE

Items	Unit	Units Done To Date	Ultimate Units	Oper. Costs To Date	Actual Unit Costs	Est. Unit Costs	Diff.	Gain or Loss To Date	Gain or Loss Ultimate
Fuel	Ton	15	21	$9.00	$0.60	$0.50	$0.10*	$1.50*	$2.10*
Cement	Bbl.	700	1,100	126.00	.18	.20	.02	14.00	22.00
Gravel	Cu.yd.	650	1,100	104.00	.16	.15	.01*	6.50*	11.00*
Sand	Cu.yd.	320	550	51.20	.16	.15	.01*	3.20*	5.50*
Form lumber	M.ft. b.m.	14	14	42.00	3.00	2.00	1.00*	14.00*	14.00
Misc. plank	M.ft. b.m.	6	6	12.00	2.00	2.00	.....	.....	.....
Earth excavation	Cu.yd.	650	700	500.50	.77	.80	.03	19.50	21.00
Concrete	Cu.yd.	600	1,100	1,080.00	1.80	2.00	.20	120.00	220.00
Building form panels	Sq.ft.	3,800	3,800	456.00	.12	.10	.02*	76.00*	76.00*
Erecting form panels	Sq.ft.	18,000	22,000	3,060.00	.17	.15	.02*	360.00*	440.00*
Stripping forms	Sq.ft.	15,000	22,000	600.00	.04	.05	.01	150.00	220.00
Rubbed surface	Sq.ft.	1,500	9,000	165.00	.11	.10	.01*	15.00*	90.00*
Operating cost to date				$6,205.70					
Operating loss to date								$172.70*	
Ultimate operating loss									$155.60*

Note: Losses are shown by an asterisk, thus: $0.10*; all other amounts in the gain or loss columns are gains.

mated unit costs. Changes can be made as occasion requires, the last line in this section showing the latest information as to ultimate quantities. An adding machine listing of the amounts in the last line of this section gives the theoretical cost at any time.

Sec. *D* receives the postings from the contract journal or other source of original entry and shows the total cost of the item and the unit cost.

Sec. *C* shows gains or losses in comparison with estimated unit cost. An adding machine listing of the last column gives total gain or loss to date.

A report of operating gain or loss can be made at any frequent interval without reference to the postings on the cost sheets, Table VI, by using a separate sheet, Table VII. This is merely the operating portion of Table V with the addition of a section showing gains or losses to date. Operating costs on each item can be accumulated daily and the unit cost on each item posted at any time to the operating gain or loss sheet. The operating gain or loss can then be arrived at daily or weekly, the totals from this sheet posted to the cost sheet, Table VI, and a complete cost report made.

Tornado Destruction in Southern Illinois

Early Reports of Havoc Wrought by Great Storm Traversing Coal Regions North of Cairo—Modern Engineering Structures Resist Well—Concrete Stacks Survive—Steel Bridge Displaced

A TORNADO that originated in eastern Missouri swept through southern Illinois, northern part of Kentucky and southwestern Indiana between 2:30 and 3:15 p.m., March 18; as we go to press the latest compilations of casualties indicate that 827 persons in over 30 towns were killed and about 3,000 were injured. Southern Illinois was the heaviest sufferer, about 650 being killed, half of them in Murphysboro and West Frankfort.

According to the U. S. Weather Bureau at Washington there probably were four distinct tornadoes, of which the principal one started near Annapolis, Mo., 67 miles west of the Mississippi, entered Illinois at Gorham, crossed the southern tip of the state in a straight line to Crossville, and ended just beyond Princeton, Ind., a total path of 185 miles. This storm passed over a large number of villages and towns, and the widespread destruction is due to this fact; prior tornadoes of comparable intensity resulted in small loss of life and property because they passed over open country. A second storm, believed to be separate from the first, originated near Elizabeth, Ind., and ended after a course of 15 miles, when approaching Louisville, Ky. The third storm rose in Sumner County, Tenn., and moved 140 miles across Kentucky to Lexington. The fourth storm, originating near Tuscumbia, Mo., ended after very short northeasterly course .

Brief wire reports of first-aid work by state sanitary engineers and of observed effects on structures are printed below.

Emergency Sanitation Work

By Harry F. Ferguson
Chief Sanitary Engineer, State Department of Health, Springfield, Illinois

THE TORNADO passed through southern Illinois about 2:30 to 3:15 p.m., March 18. It struck Murphysboro at 2:35, Bush at 2:45, West Frankfort at 3. Word of the disaster reached the sanitary engineering division of the state department of health at 8 p.m. Within twenty minutes engineer A. F. Doppert left Springfield with other relief workers on a special train, arriving at Murphysboro at 2 a.m. Thursday, March 19. Emergency sanitary work was started at once in charge of engineers of the state sanitary engineering division (A. F. Doppert, M. S. Sabin, M. LeBosquet, V. B. Lamoureux and H. F. Ferguson), in co-operation with local sanitary committees, volunteer workers and medical units of the state militia. By 4 p.m. the working organization was complete.

Water Supply—The communities in the path of the tornado were Gorham, Murphysboro, De Soto, Hurst, Bush, West Frankfort and Parrish. Murphysboro and West Frankfort had public water supply systems. The water at Murphysboro is normally filtered and chlorinated. Because of fire damage immediately following the tornado untreated water was pumped into the mains for a few hours. The sanitary engineers on arrival placed the treatment plant again in service, increased the chlorine dosage and posted notices warning that water should be boiled until the mains were freed of polluted water. The West Frankfort public water supply was untreated river water. Drinking water was obtained from private wells, and distilled water from ice plants. A chlorinator was installed at once to make the public supply safe. All wells and cisterns in the tornado area subject to contamination were dosed with hypochlorite of lime. Those suitably constructed were labeled "Treated"; others, though treated, were labeled "Dangerous," as a precautionary measure.

Wastes—Privy vaults were cleaned or filled in and dosed with quicklime. Dead animals—many horses and cows and hundreds of smaller domestic animals—were burned or treated with quicklime and buried. Garbage collection and disposal systems were planned to prevent accumulation of such wastes and fly-breeding places. These communities before the tornado had no regular garbage system.

Camp Housing—Tent camps to house refugees and labor for rebuilding the devastated areas are being established, especially at Murphysboro. These are being laid out by sanitary engineers, and water supply and sewage disposal facilities provided.

Continued Work—No waterborne diseases or illnesses that might result from insanitary conditions have occurred to date, evidencing the effectiveness of the local control and sanitary engineering services. To follow the emergency sanitary work, plans are being developed to improve the public water and sewer systems and general sanitary conditions so that they will be better than before the tornado. A water filtration plant and water and sewer extensions are under consideration at West Frankfort and Carbondale, the latter of which was not in the path of the tornado but served as a relief center.

Complete mosquito control may be carried on in Murphysboro to prevent malaria which has in the past been prevalent in that city.

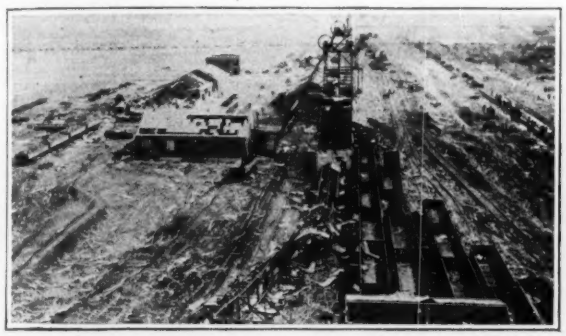
Damage to Mine Structures

(From telegraph reports to "Coal Age")

REPORTS on damage to coal-mine structures indicate that modern engineering structures came through the tornado well, although two of the three large mines at West Frankfort were directly in the storm path, two of them are already in shape to operate; the third will be out of commission for some months.

At Murphysboro, the only two mines now operating were north of the storm track. The same was true of the operating mines at De Soto, Bush, and Hurst.

West Frankfort, a town of 15,000 people, had three huge mines. Orient No. 1 mine, at the westerly edge of the town, was in the outer part of the storm, and its works stood firm. New Orient, completed last year by the Chicago, Wilmington & Franklin Coal Co., which was to be the greatest coal mine in the world, was directly in the path of the storm, however, and its great steel rescreening plant and tipple were exposed to the full force of the wind.



TOP WORKS OF NEW ORIENT MINE AND WRECKED SHOP BUILDING

J. V. Carroll, who was in the scale house, says that the nature of the approaching storm was not evident until he saw a wooden house three blocks away suddenly shoot into the air and explode. In a moment the tornado had gone by. Men in the tall rescreener house said they felt it sway strongly to one side until the sheeting began to rip off. The tipple behaved in the same manner. The hoist house had part of the tile roof taken off. The conveyor to top of main tipple twisted in two. A locomotive crane standing on a trestle which partly protected the wash house tipped over and broke down part of the wash-house roof. Empty coal cars were blown off the trestle. A water tank on a high steel tower was lifted and dropped, without striking a building. The shop building, a brick, steel and tile structure about 100 ft. long, was caved in, doing some damage to the machine tools within. Near by a low building in which explosives were stored disappeared completely, leaving the boxes of powder neatly stacked. A two-story brick and tile office building at the east end of the group, had windows and doors blown out, but the building stood. The outdoor electric substation was damaged.

Half a mile east of here the freight and engine terminals of the Chicago & Eastern Illinois R.R. were heavily damaged. The roundhouse, coaling station, water tank and many minor buildings were destroyed.

A little further east was the Peabody No. 19 coal mine, with steel top works built about twelve years ago. The stacks went down and the roof of the boiler house was ripped off, but practically no damage was done to tipple, hoist house, headframe, and fan house. The mine was able to reopen after five days. On the other hand, Peabody No. 18 mine, an older mine, whose steel structures were of lighter type, was wiped clean.

Effects on Engineering Structures

By C. R. Dooling
Assistant Engineer, State Division of Highways, Carbondale

IN THE larger communities there are many engineering structures that furnish a good example of the ability of different types of construction to resist the terrific force of such a storm.

Damage at Murphysboro—At Murphysboro a clean sweep was made through the northwest part of the city. The Mobile & Ohio shops suffered the greatest damage in this vicinity, as what was left after the tornado was destroyed by fire. Within 300 ft. of the shops two reinforced-concrete coalbins about 40 ft. high are standing alone, undamaged, in the midst of a vast amount of wreckage. Also near the railroad shops two steel wheat bins belonging to the Reliance Milling Co. are still intact, although one of the bins is now leaning.

The brick building of the Brown Shoe Co., Murphysboro, was damaged considerably. Immediately in the rear there is a 160-ft. reinforced-concrete smokestack. In spite of the great amount of destruction around the structure the stack remains standing and does not show signs of any damage whatever. A small two-story building of plain concrete was practically destroyed, its 8-in. walls being sheared off entirely at the top of the first floor. The Murphysboro township high school, a building of brick and steel construction, was demolished, brick walls down, steel roof trusses wrecked.

Steel Bridge Lifted—On the Zeigler Branch of the Illinois Central R.R. a 160-ft. steel span over the Big Muddy River was actually lifted from the piers, being moved 6 ft. on one end and 21 in. on the other. The steel members were not damaged as the span was lifted back into place and traffic resumed within a short time. However, there is evidence that the span was actually lifted from the piers as the rollers were found on the ground around the pier.

West Frankfort—At West Frankfort the storm demolished practically every home. The New Orient mine came within its path. While the steel tipple and brick building do not show much damage, smaller buildings were wrecked, coal cars overturned, an automobile carried 500 ft. into a field. A reinforced-concrete smokestack stands here similar to the one at Murphysboro. This stack is about 150 ft. high and shows no apparent damage. Within 200 ft. of it is a steel water-tower which was wrecked by the force of the wind; the tank itself was about 15 ft. high and was supported by 20-ft. steel columns. The tank, which was practically filled at the time, was not greatly damaged, but the steel columns failed, dropping the tank.

One of a Series of Articles on the Details of Design and Layout of Different Types of Industrial Buildings

Reconstruction of Dye-House at a Textile Mill

New Structure Built Around One-Story Mill in Operation—Concrete First Story with Mill Type Above—Double Skylights and Cork Board Prevent Condensation

IN ENLARGING manufacturing plants in New England two factors which often influence the design and execution of the work are conservation of available area and continuity of operation without loss of production capacity. An example of work done under these conditions is the reconstruction of the dye-house for the Monument Mills at Housatonic, Mass., where a one- and two-story wooden building was replaced by a three-story building without interruption to the manufacturing processes in the old structure. The length in both cases was 237 ft., but the old building was 42 ft. wide while the new building, shown in Fig. 1, tapers from 69 to 49 ft. A special feature of the new structure is the combination of reinforced-concrete lower walls and second-story floor slab, with a superstructure having cast-iron columns, steel beams and brick walls. Dyeing and bleaching are done on the first floor; the slashers and warpers are on the second floor, while the third floor provides storage for warps and yarn and spare space for future additional machinery.

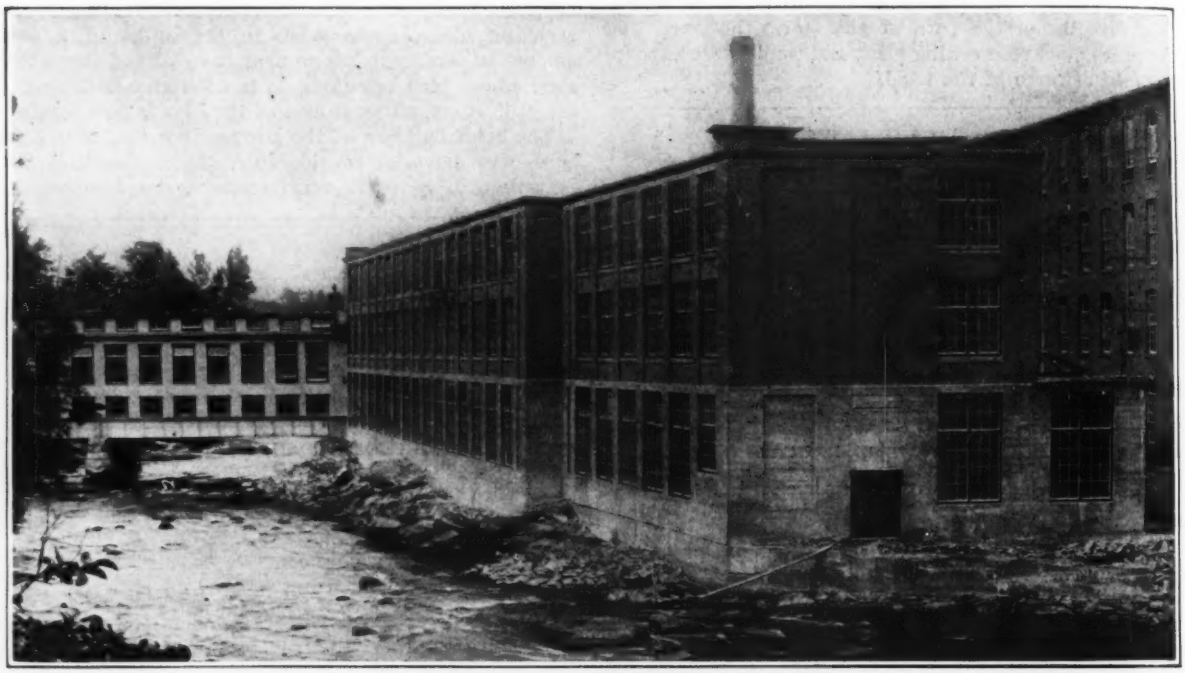


FIG. 1—NEW DYE-HOUSE OF MONUMENT MILLS
Concrete below; mill construction above. Width reduced in upper stories to prevent darkening of adjacent spinning mill.

At the Monument Mills, which manufacture cotton warp yarns and fancy bedspreads, the spinning plant stretches between the west bank of the Housatonic River and the main tracks of the New York, New Haven & Hartford R.R. for a distance of about 1,500 ft., with a width of 100 to 200 ft. At the upstream end is a dam impounding the water of the river, from which the plant derives a large part of its power. As shown by Fig. 2, the old dye-house was between the spinning mill and the river bank; it was a wooden structure, one and two stories in height, adjoining an abandoned boiler house. Between the dye-house and the mill was an old wooden penstock leading to a waterwheel in an adjacent building. Under the mill another penstock led to a second wheel located within the mill. It was decided to abandon both of these wheels and to build a new penstock passing under the new mill and serving the new power plant situated 700 ft. below the dam.

As nearly all of the yarn made at this mill passes through the dye-house, the production of finished goods is dependent on the uninterrupted use of the dyeing and bleaching equipment. A cross-section of the new dye house, Fig. 2, shows in dotted lines the main mill and the old dye-house building. To protect the machinery and insure its continuous operation, a substantial temporary roof was first erected just below the roof of the old dye house and supported on the lower chords of the old trusses, which in turn were strengthened by shores. This temporary roof was designed to carry shores for the forms of the new second floor, which is of reinforced-concrete, flat-slab design, and 20x-23-ft. bays. This column spacing was governed both by the machinery layout and the shape of the site. Although the building was narrow, the flat-slab type of construction was adopted as an aid to proper ventilation required by the absence of beams or joists.

For the upper stories a modified mill type of construction was adopted, using brick walls, steel beams and girders, hard pine plank on spiking pieces and maple top surface. This construction above the concrete of the first story was found to be economical for the loads for which the building was designed. The second floor was made up of creosoted hard pine plank bedded in ¾ in. of tar-sand laid on the reinforced-concrete slab. A maple top surface was nailed to the creosoted plank. This tar-sand construction is widely used where a plank floor is to be laid over a concrete slab and these were insulated by means of glazed wooden sash placed horizontally in the roof openings. This use of horizontal sash under the skylights is a regular practice with the designers of the mill, since it is found that to a large extent it prevents interior condensation and reduces the loss of heat through the skylights.

It will be noted that the first story is of considerable height, 17½ ft. from floor to floor. This arrangement was adopted mainly for the purpose of bringing the new second floor level with that of the adjacent spinning mill, to which it is connected by a bridge. But the height is also of considerable advantage in the dye-

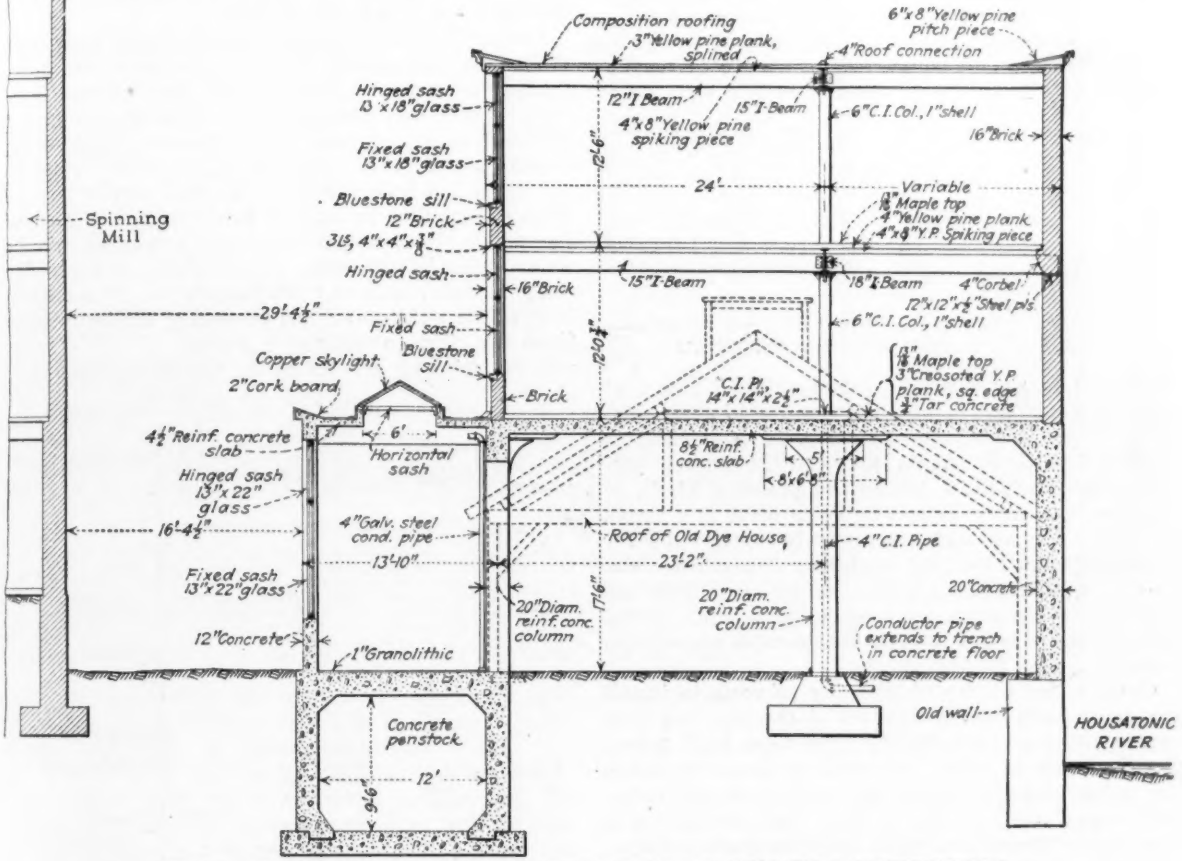


FIG. 2—DYE-HOUSE OF COMBINATION CONCRETE AND MILL-TYPE CONSTRUCTION

and it has proved very satisfactory where light machinery is to be used. After the superstructure of the new building was finished, a concrete floor with granolithic wearing surface was laid on the ground in that portion where there was no machinery in operation, without loss of production. This new floor contained trenches and drains to carry off liquids from the dyeing machines. A live-load of 100 lb. per square foot was used in the floor designs.

The west wall of the dye-house was placed 16 ft. from the spinning mill, leaving just room for the passage of trucks and fire apparatus, while the east wall followed the river bank. To prevent the shading effect of the high new building on the lower floors of the older mill, the two upper stories were set back about 14 ft., leaving a clear space above of 30 ft. between the buildings. The roof of the one-story portion was insulated with 2-in. corkboard to prevent interior condensation. A large portion of this roof was covered with skylights house as an aid to ventilation. Windows have wood sash, glazed, with clear glass, and movable sash for natural ventilation. No provision for taking care of condensation was made, except on the roof of the one-story section where 2-in. cork insulation was laid on the roof and horizontal sash placed below the skylights, as noted above. No condensation occurs on the ceiling beneath the second floor, as it is heated on both sides. Inserts placed in the slab of the second floor when the concrete was poured support the sprinkler system, electric wiring conduits, shafting and other fixtures in the first story. For handling material, the only mechanical appliances are the freight elevators. The interior of the building is painted white, a special paint being used in the dye-house and bleach-house.

Concrete Penstock—The new penstock, which required a cross-sectional area of about 100 sq.ft., was placed under the dye-house building, its side walls being used as foundations of the building, as shown in Fig. 2.

Along part of its length its roof carries the columns of the beaming building, the penstock roof slab being reinforced accordingly. This penstock is 12 ft. wide and 9½ ft. high inside, with a length of about 400 ft. To ensure dense and watertight concrete, hydrated lime was added dry to the cement in the proportion of 8 per cent of weight; thorough spading was specified for the interior and exterior surfaces and it was required that special care be given to obtaining a smooth and uniform interior surface. In the formwork, wires were not permitted to extend through the concrete. This penstock, designed to sustain a hydraulic head of 35 ft. and to carry the new building, was found to be perfectly watertight under these conditions. Expansion joints built in it at about 20-ft. intervals, to take care of the possibility of cracks and lateral movement, are of tongue-and-groove type in the walls and bottom slab, while

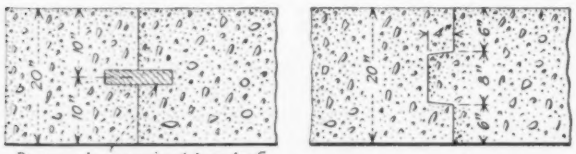

Dense, close-grained long leaf yellow pine, painted with hot creosote
Joint in Top Slab
Joint
Inside Walls and Bottom Slab

FIG. 3—EXPANSION JOINTS IN PENSTOCK

in the roof they are butt joints with an insert of 2x10-in. plank painted with hot creosote to allow shipping. These joints, shown in Fig. 3, were made as construction joints. At its lower end the concrete penstock connects with a wood-stave penstock 11 ft. in diameter, the change in section being made in a length of 16½ ft. The penstock also serves to supply water for the dyeing and bleaching machinery through a 10-in. pipe built into it directly under the dye-house floor, and protected by the necessary screens and valves. As the water in the penstock is under considerable pressure no pump is needed for this supply.

Construction Work—There being no room to install the contractor's concreting plant at the site, two temporary bridges about 200 ft. long were built across the river, one of which was used by teams removing the excavated material, and the other to transport the concrete. For this latter service, 1-yd. concrete cars were used, running by gravity from the concrete mixer, which was located high up on the opposite bank, to just above the level of the second floor.

This new mill building and its accessories were designed for the Monument Mills by F. P. Sheldon & Son, engineers and architects, Providence, R. I.; the contractors were F. T. Ley & Co., Springfield, Mass., with O. W. Miller as superintendent in charge of construction.

Channel Widening at La Pita Bend, Panama

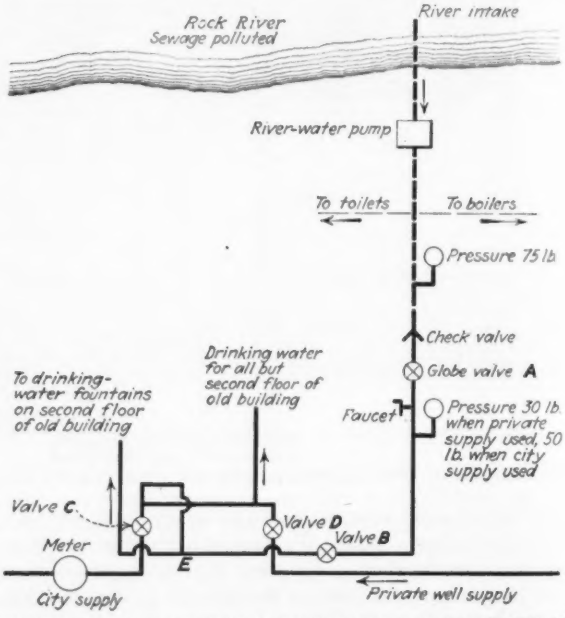
The work of widening the channel at La Pita Bend, in the Panama Canal, which was commenced in July, 1922, and involved the removal of 1,244,000 cu.yd. of material, including approximately 92 per cent of rock, was completed during the month of December, 1924, and the channel was opened to traffic the latter part of the month. The total amount of material removed was only 24,700 cu.yd. in excess of the original estimate, and the percentage of rock exceeded the original figures by 12 per cent.

Typhoid Fever and Cross-Connections in Illinois

CROSS-CONNECTIONS between piping systems carrying polluted water and piping systems carrying city water have caused a number of water-borne typhoid outbreaks in Illinois. During the past decade Elgin, Bloomington and Maywood have added their names to this list and now the cities of Sterling and Rock Falls, according to H. F. Ferguson, chief sanitary engineer of the Illinois Department of Public Health, have joined those cities where unnecessary sickness has resulted from thoughtlessness and carelessness in permitting cross-connections to exist.

During the latter part of December and early part of January, just passed, 12 cases of typhoid and paratyphoid fever were reported from Sterling and Rock Falls. These two communities are located on opposite banks of Rock River and have a common public water supply owned and operated by a water company. Attention had been called by the State Department of Health from time to time to the possible pollution of the public water supply by cross-connections at the water-works plant, but, notwithstanding that, the water company and city officials allowed cross-connections at the water-works and in some of the factories in those two cities to continue in place.

Upon receiving reports of the typhoid in those two



WATER PIPING AND CROSS-CONNECTION AT FACTORY AT STERLING, ILL.

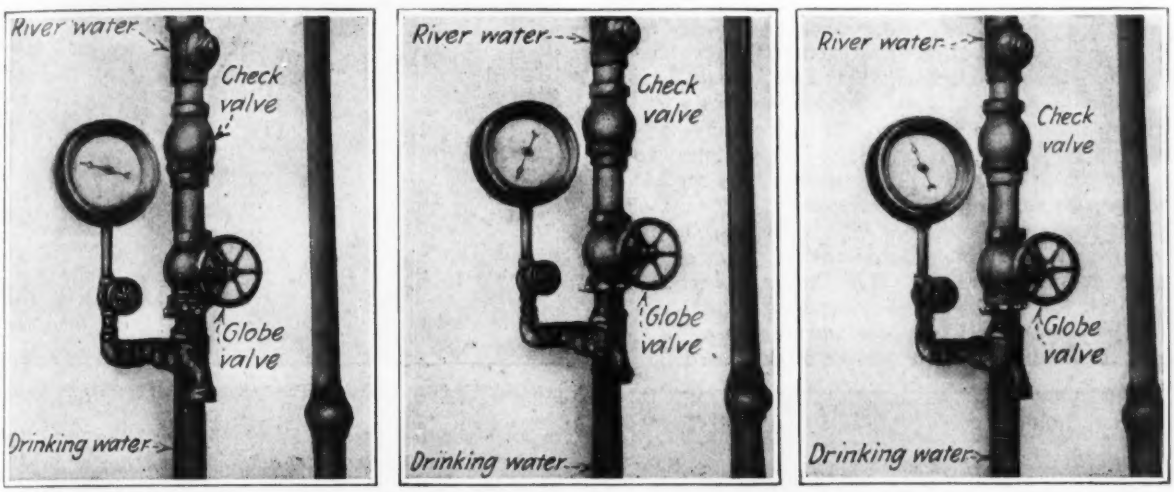
communities, investigation by a sanitary engineer and health officer of the State Health Department showed that all the cases were employees at a single factory. A check-up on the piping system in that factory showed a cross-connection between a polluted river-water-supply system and a piping system connected to the city mains. Fig. 1 shows diagrammatically the arrangement of the the piping.

Water was pumped from the river for the boilers and for flushing toilets. This water was separated from the rest of the piping which supplied the drinking fountains by means of a check valve and globe valve *A*

shown on the sketch. Sometimes city water and sometimes the private well water was used to supply the drinking water at the factory. The normal pressure on the river-water line was about 75 lb. and on the city and well-water line 30 to 50 lb. Consequently if the check valve and valve *A* leaked, the polluted water would pass into the other piping system. That was what actually happened. By closing valve *B* and opening and then closing the faucet near valve *A* and reading the pressure gages it was found that the check valve and valve *A* were leaking quite badly notwithstanding the fact that the globe valve *A* was closed as tight as possible.

An interesting feature of this epidemic is the fact that the cases were all confined to employees who worked on the second floor of the old building. A study of the hydraulics of the piping layout shows that, assuming normal draft on the drinking-water mains at the drinking fountains, it would be expected that the leakage from the river-water line would pass to the pipe supplying the second floor of the old building where the cases occurred. If the leakage had increased or if the valves on the second floor line had been closed, then the contamination would also have gone to other parts of the factory, causing a more disastrous epidemic.

The factory management, in the opinion of the State Board of Health, is responsible for this illness, but in turn the water company and the city officials of the two communities share the responsibility. There have been two deaths.



WATER GAGE READING TO SHOW VALVE LEAKAGE

In the picture at the left the globe valve was closed and a valve (which is not shown) on the drinking-water line was left open and the gage thus registers the pressure in the drinking-water system. In the middle picture both the river-water valves shown and the drinking-water valve not shown were closed and the faucet between the two sets of valves was opened in order to drain that portion of the pipe. The gage registers zero. In the right-hand picture the faucet had been closed, at the same time leaving all the valves closed. The pressure as registered by the gage increased to the pressure prevailing in the river-water system, thus proving that the check and globe valves controlling the river-water supply were leaking.
To make the picture complete, says Mr. Ferguson, there should be included the pictures of the twelve typhoid cases and two coffins.

Proper Shape of Unsymmetrically Loaded Arch

Information is asked by a reader as to a method of determining the proper form of a concrete barrel arch of approximately segmental shape, carrying a roadway on grade. The two ends of the arch are at different elevations. The rise of the arch from the two abutments and the depth of fill over the crown are known; it is required to determine the position of the crown of the arch, having regard to the unequal loading due to the grade of the surface of the fill.

Endurance of Non-Ferrous Metals

RESULTS of endurance tests on non-ferrous metals and alloys, published by D. J. McAdam, Jr., metallurgist of the Naval Engineering Experiment Station at Annapolis (*Trans. Am. Soc. for Steel Treating*, January and February, 1925) indicate distinct differences from the endurance behavior of steel, and show that cold-working has an unfavorable influence on endurance.

The investigation included nickel, monel metal, constantan, cupro-nickel, several ternary alloys of nickel, copper, alpha bronze, alpha brass, aluminum bronze, Muntz metal, naval brass and manganese bronze. Endurance tests were made by the rotating-cantilever method and by the alternating-torsion accelerated-method.

Each of the metals exhibited a definite endurance limit. The abscissa at which the graph becomes nearly horizontal varies with the kind of material, from about 20,000,000 to 200,000,000, but in all cases the endurance limit is indicated approximately by endurance tests of not more than 50,000,000 cycles. Investigation of the effect of severe and moderate cold working on endurance indicates that severe cold working lowers the endurance ratio, but moderate cold working has little if any effect.

On the basis of these conclusions the endurance limits of annealed alloys are calculated from the endurance limits of all the alloys as rolled or drawn. These endurance limits are utilized in graphs to illustrate the influence of composition on binary nickel-copper, copper-zinc, copper-aluminum, and copper-tin alloys.

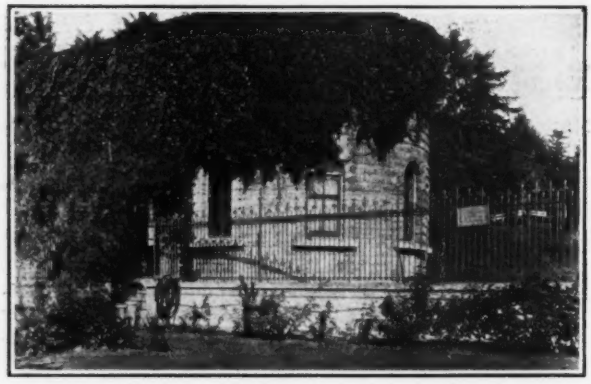
There is a decided advantage in so adjusting the chemical composition as to obtain as high as possible an endurance limit in the annealed condition. For this purpose the most promising of these alloys are the nickel-copper alloys having 45 to 65 per cent nickel. The copper-zinc alloys show the lowest endurance properties of any of the four series of binary alloys.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Sands in Molds Gives Attractive Finish To Precast Concrete Blocks

IN a building contract recently carried out for the city of Portland, Ore., the contractor devised an unusual method to meet an unusual provision in the specifications. The requirement was that a new gate and screen house for the city water-works should be built of monolithic concrete. The other provision was that it harmonize with the surroundings; that is, it should have an exterior appearance resembling as nearly as possible an old concrete building in which the concrete had been poured between forms and later hand-chipped to resemble cut stone. This requirement was met in an inexpensive and entirely satisfactory manner by taking photographs of the old building and from the photographs making sixteen patterns in plaster-of-paris. These patterns were about 3 in. thick and were chipped by hand to resemble the photographs. They were approximately 10x28 in. in size and were used to shape sand molds in a manner similar to that used by iron



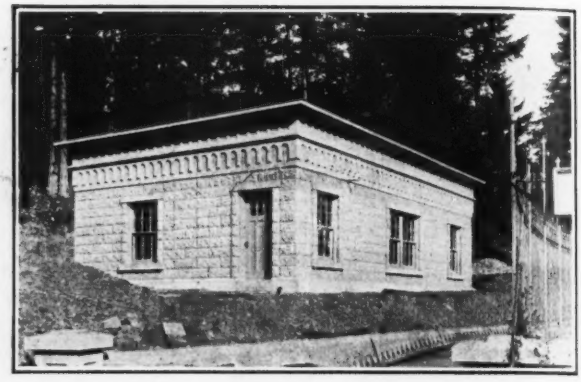
OLD BUILDING VENEERED WITH CHIPPED CONCRETE

molders. The thickness of the wall poured monolithic behind these veneer blocks was 7 in., while the veneer blocks, after being chipped were 2½ in. thick, a half inch having been lost in the chipping.

The new gate house was erected by building up forms consisting of the precast veneer blocks on the outside and ordinary wood forms, well braced in both directions, as the inner side, the space between being filled with concrete. Anchors of wire and short steel rods were used to support the veneer prior to pouring the concrete and to tie it into the main wall after the concrete had set. A fact that had much to do with the success of this method of construction was that a considerable amount of free sand from the molds was embedded in and adhered to the outer surface of the veneer blocks. This gave to the finished structure a velvety, sandstone appearance very much like that gained in the original hand-chipped structure. This effect would not have been possible had the blocks been cast in iron molds.

In pouring the veneer a 1:2:4 cement mix was used. The patterns showed practically no wear and it is believed that they could be used an indefinite number of times.

The total cost of the structure was about $1,800, well within the sum allotted for that purpose as compared



MOLDED CONCRETE DUPLICATING THE HAND FINISH

to an estimated cost of about $5,000 if the work had been performed by the hand chipping method at present day-labor cost.

Contract for this work was held by the J. W. Sadler Co. of Portland, Ore., and the work was under the supervision of L. E. Bufton, who devised the method described in the foregoing.

Boulder Canyon Dam in Miniature

TO HELP visualize the physical characteristics of the Colorado River gorge at the site of the proposed Boulder Canyon dam, William Mulholland, chief engineer, Los Angeles Water and Power Bureau, has had made up in his drafting room a relief map on a scale of 40 ft. to the inch which represents about a half-mile length of the gorge in the vicinity of the dam site.

The map is about 30x56 in. in plan and the canyon walls have a maximum height of about 28 in. These walls were built up by sawing out of ¼-in. 3-ply spruce veneer the contour lines as shown on the U. S. Geological Survey topographical sheets. The ¼-in. lifts represent the space between contour lines on 10-ft. intervals. The veneer has been found to keep its shape very well and its thickness lends itself well to the scale adopted.

Built up, as a separate structure so it could be fitted into the canyon at the exact site, is a dam made up of the same materials as the walls and proportioned to represent a rock-fill dam, 610 ft. high above low water having 1½:1 slopes on both faces. This dam is made in two sections weighing about 60 lb. and each section is provided with handles to facilitate lifting it out of the canyon. The structure it represents would contain about 12,000,000 cu.yd. A second dam to represent the concrete structure designed as an alternative for the same site is now under construction.

Bad Design of Short-Span Steel Trusses

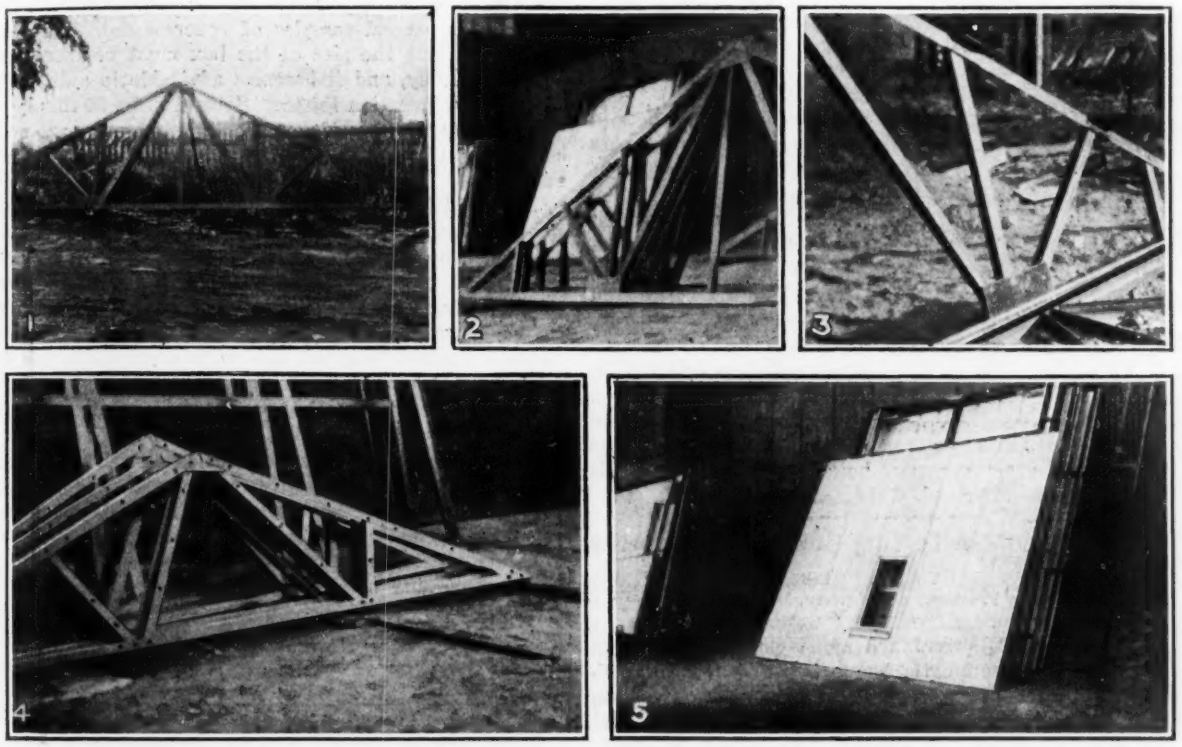
By Jacob Feld
Engineer, Brooklyn, N. Y.

THE increasing tendency to the general use of fireproof construction, especially where the municipal building departments have jurisdiction, has caused the expansion of several small tinsmith and ornamental metal firms to include the manufacture of steel trusses and "all steel fireproof" one-story buildings. A remarkable lack of construction sense is exhibited by many of these structural-steel fabricators and there is a surprising similarity in both the construction methods and the sales literature of these firms; probably another instance of that unexplainable coincidence of independent simultaneous development.

The trusses usually vary from 10 to 30 ft. in span and are used for garage, service station and small factory roofs. The top chord of all spans slopes 1:2 to the horizontal. According to the New York Building Code, this slope permits a design on the basis of 30 lb. per square foot horizontal projection for live-load, while a flatter slope must be designed for 40 lb. per square foot. The truss spacing varies from 8 to 10 ft.

The writer recently made for one of the oldest firms in the field of "all steel garage" construction a design drawn up in accordance with some special rulings of the Brooklyn Building Department, which office also approved the plans and the garages. The plans were personally explained to the sales manager, the erection superintendent and the foreman of the shop and the trusses were built according to the plans. Before making these plans, for trusses of six different spans, the writer had visited the shop and found designs herewith pictured, deficiencies of which are more or less obvious. One especially caught his attention—an 18-ft. span, both chords of single 2x2x$\frac{1}{4}$-in. angles, all web members of 3x3x$\frac{1}{4}$-in. or $\frac{3}{8}$-in. angles, with far from enough rivets and those in the wrong places. Photographs of similarly deficient designs were secured elsewhere.

Fig. 1 is an elevation of a pair of 20-ft. spans drying out after the final painting. A casual glance shows nothing wrong. Some structural engineers who were shown these pictures commented upon the very good appearance of the trusses. Fig. 2 is a front view of a set of 20-ft. spans from the front and Fig. 3 is a similar set from the rear. All the members are



EXAMPLES OF BAD PRACTICE IN TRUSS DESIGN

Fig. 1—Elevation of pair of 20-ft. spans, drying out after painting. Fig. 2—Front view of 20-ft. span truss. Fig. 3—Rear view of same truss. Fig. 4—Detail of 12-ft. span. Fig. 5—Steel frames for sidewall panels.

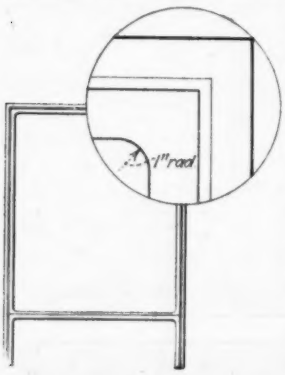
2x2x$\frac{1}{4}$-in. single angles. Actual measurement of several trusses failed to show one angle with a 2-in. leg; the variation was between $1\frac{3}{4}$ and $1\frac{7}{8}$ in. Note especially the omission of the web member in the second panel; this is very common. One builder even tried to form an overhanging roof by supporting the truss 12 in. from the second panel point from the end and complained to the writer when the Building Department refused to issue a permit for the building. Half-inch hand-driven rivets were used in these trusses; sometimes $\frac{3}{8}$-in. rivets are used, the decision resting with the foreman of the shop. One hand-driven $\frac{1}{2}$-in. rivet has but little strength in single shear and yet these trusses usually stand up, the writer having heard of only one failure and that during erection.

Fig. 4 is a 12-ft. span showing similar construction. Note the rivet holes (near some of the connections) which are not used; the gusset plates probably refused to stretch. The holes in the top chord between panel points are for connecting clip angles for attaching roofing.

The real secret for the apparent refusal of these trusses to obey the laws of gravitation is shown in Fig. 5; the side wall panels are well made and are tied together underneath each truss. There are a great number of such trusses in actual use at present and a great number are being built and erected to shelter life and property. Is it not about time that some method for stopping such atrocities was found and *enforced?*

Round-Corner Window Sash

THAT round-cornered windows, as adopted for the Tribune Tower Building, in Chicago, will save their extra cost by the reduced time and expense for window cleaning, is the claim made for this special detail in the design of large buildings. From the accompanying drawing, it will be seen that the novelty consists in rounding all sash corners to 1-in. radius instead of making them square. Another feature which effects a material saving in cost is the omission of sash locks, which are considered unnecessary since the windows of skyscraper buildings are practically inaccessible from the outside. These innovations are due to the architects of the building, John M. Howells and Raymond M. Hood, Chicago, Illinois.



WINDOW WITH ROUNDED CORNERS

Improvements in Testing Concrete Specimens

BY S. H. SHEIB
Secretary, Froehling & Robertson, Inc., Chemists, Richmond, Va.

AN IMPROVED combined moist closet and storage tank with automatic temperature control for curing concrete specimens under test has recently been developed by Froehling & Robertson, Inc. (Richmond Testing Laboratory), Richmond, Va., and after several months' trial has been adopted as part of this firm's standard equipment.

The apparatus consists essentially of a refrigerator, preferably top icing, on the bottom of which are placed two rectangular galvanized iron tanks 7 in. deep. These tanks are of such a size as to cover the bottom with the exception of an intervening space wide enough to receive two or three lamp bulbs, or other suitable heating units, connected in multiple. This circuit is controlled by a thermostat in series, which is set for the standard temperature of 70 deg. F.

The tanks are used for storing the 7-day and 28-day briquets, and take the place of the usual water pan. In order to increase humidity to maximum, the lamp bulbs are half covered with wicks dipping into a separate vessel of water placed between the tanks.

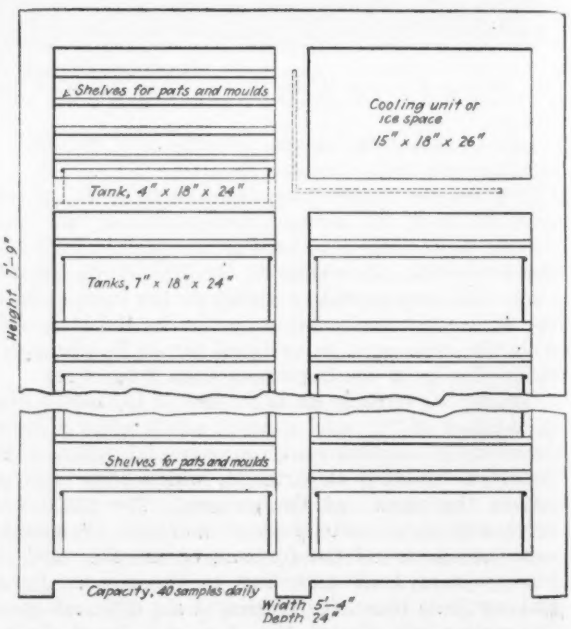
Grid shelves above the tanks support the pat plates and briquet molds during the 24-hr. period, allowing free air circulation.

During cold weather the thermostat automatically holds the temperature of the refrigerator at 70 deg. continuously, but in warm weather or in overheated rooms it becomes necessary to use ice which should be partially covered with a cloth in order to prevent excessive lowering of temperature and consequent waste. The ice is of course placed in the ice compartment as usual and the thermostat prevents the temperature from falling below 70 deg.

The apparatus functions in a manner that leaves little to be desired, and constitutes an important improvement in concrete testing equipment. The ordinary refrigerator of 75-lb. or 100-lb. ice capacity is large enough for several samples of concrete daily, but for more than this the size of the box must be increased proportionately, and it becomes advisable to substitute electric refrigeration for ice. Several units of this type with a daily capacity of forty to eighty samples are now under construction and will be installed in the near future.

The need for equipment of this sort is strongly emphasized by the Bureau of Public Roads in the November, 1924, number of *Public Roads*, in which attention is directed to the wide variation in temperatures reported in tests made of Standard Cement Sample Ct. 5, in which work a large number of laboratories participated. Certain cements are very susceptible to the influence of temperature during curing, and much more uniform and trustworthy results will attend careful temperature control during testing.

A further refinement introduced by this firm consists in regulating the humidity of the laboratory air during the mixing of pastes and mortars, it having been discovered that both will lose an appreciable amount of moisture during manipulation in dry air sufficiently to affect results seriously. Relative humidity of the laboratory air is therefore regularly determined before preparing mortars, and if found deficient, is raised by wetting the floor or setting pans of water to boiling.


Shelves for pats and moulds
Cooling unit or ice space
15" x 18" x 26"
Tank, 4" x 18" x 24"
Tanks, 7" x 18" x 24"
Height 7'-9"
Shelves for pats and moulds
Capacity, 40 samples daily
Width 5'-4"
Depth 24"

MOIST CLOSET FOR CURING CONCRETE TEST SPECIMEN

From Job and Office

Hints that Cut Cost and Time

From Job and Office

For Contractor and Engineer

all doors and windows being kept closed. As the relative humidity of steam heated rooms is usually quite low, often not more than 35 per cent, an arbitrary minimum of 50 per cent has been adopted. Further study may demand a modification of this limit.

Results of tests of check samples made in different laboratories employing these improved methods show remarkable uniformity and close agreement.

Box Bulkhead Used in Repair of Valves in Canal Lock

By F. Y. Parker

Assistant Engineer, U. S. Engineer Office, Kansas City, Mo.

ELEVEN years after Lock No. 1 on the Osage River in Missouri had been put in commission the filling wickets under the miter sill wall of the upper gate, and four emptying valves in the lower gate ceased to operate and made it necessary to unwater them for repairs. The month of February was selected as the best one for such work because traffic is light during that month and the river stage low and fairly constant. A cofferdam across the canal was decided upon as the best method of unwatering the valves of the upper gate, and the use of a box bulkhead as best for the lower gate.

At the time of unwatering the gage was approximately 1 ft. above standard low water, giving a head of 8 ft. on the upper row of sheetpiling and 12 ft. on the lower. The difference of head was due to the footing of the upper piling resting on the upstream extension of the miter sill wall, at the upper gate.

The lock chamber is 42 ft. wide and has a length of 220 ft. between quoins. The chamber is filled through 6 culverts in the upper miter sill wall. These culverts are closed by wickets at their upper end, three being operated from each side on a single axis.

The lock walls are of concrete cast in place, and in each wall, approximately 23 ft. above and below each gate, vertical stoplog slots have been left. These slots measure 1½ ft. on the sides and extend from the top of the walls to the lock floor.

Scarfed oak beams (12x16x45 ft.) with a fishing piece over the scarf and 3 1-in. U-bolts clamped over the whole, were dropped in these slots above and below the upper gate; four beams in each slot. To space the timbers 6 iron rods projected 4 ft. above the top of the first 3 beams on which the second, third and fourth beams rested.

After the beams were in place, sheetpiling (3x12 in. x16 ft.) was driven along the outer edge and hung with canvas. Mixed hay and dirt then was dumped along the convas.

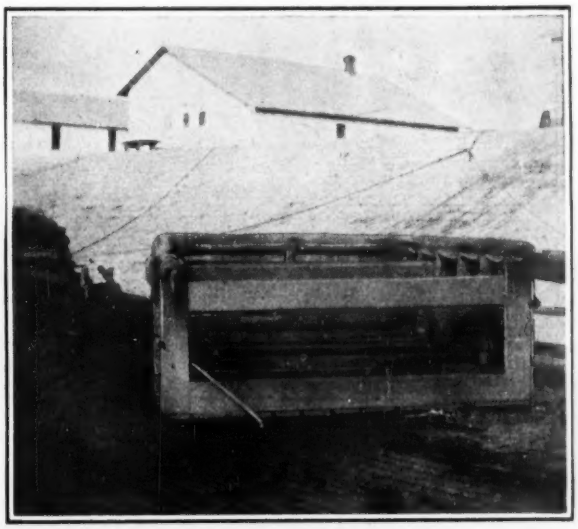
The upper gate was closed, and on the upstream side a truss was constructed between the apex of the gate and the center of the upstream side of the cofferdam. Additional bracing was placed against the lock walls and gate. On the downstream side a truss abutted on the miter sill wall and the center of the downstream side of the cofferdam, with additional bracing where needed.

Because of the difficulty of bracing any cofferdam against a threatened rise in the river, a different method was used to unwater the valves in the lower gate.

In each leaf of the lower gate there are four butterfly valves operated by rod and ratchet from the footboard of the gate.

A drydock or box bulkhead 4½x10½x16 ft. was constructed from the sheetpiling and bracing of the cofferdam, for the front half of the gate leaf, and since the valves when fully open do not project beyond the I-beam bracing, only a batten or cover was used for the rear half of the leaf.

The bulkhead was lifted into the lock chamber by a dredge derrick, weighted with three pile hammers and sunk to the floor of the lock. The gate leaf was then opened and the dock maneuvered so as to inclose the valves to be unwatered. As the bottom of the gate is



TOP VIEW OF BOX BULKHEAD SHOWING PADDING ON CONTACT EDGES

only 6 in. above the lock floor, the bottom-edge dock padding—oakum covered with canvas—was made 11 in. wide, thus allowing a margin of 5 in. for contact with the bottom of the leaf when the bulkhead rested on the lock floor. The side edges were padded to a thickness of 4 in.

The batten for the downstream side of the gate leaf covered only half of the lower panel (the spaces between intersecting I-beam frames are designated panels) in which the valves are situated, but was made wide enough to rest on the lock floor and padded over the entire face. After weighting with two steel plates nailed on the back, the batten was lowered into position and held in place by two 18-ft. poles nailed to the batten, until compression began to take its effect.

Shifting the bulkhead over the remaining valves was easily accomplished, because the small pile hammers almost equaled the buoyancy of the dock. When shifting to another pair of valves, only the large hammer was removed. The bulkhead could then be easily manipulated into position and stabilized until the large hammer could be placed.

At the time of unwatering the forces acting on the bulkhead were 24 tons vertical uplift and 10 tons normal thereto. Counteracting the vertical uplift was the weight of the bulkhead (4 tons) three pile hammers

(6 tons) and the weight of the gate leaf (17 tons). Figures are to the nearest ton. The pressure and direction of the combined forces acting on the bulkhead and gate was 11 tons, applied at an angle of 106 deg.

This work was done under the direction of Major C. C. Gee, Corps of Engineers, U.S.A., with the writer in local charge.

Using a Mechanical Road Finisher on Widened Curves

AT TIMES a contractor has need of information as to the use of a mechanical road finisher on widened curves. The following paragraph has been supplied to meet that need for information:

A false form is set around the curve for the width

FINISHING MACHINE USED ON WIDENED CURVE

of the machine and this width is spread, tamped and surfaced mechanically. The widened portion of the curve is finished by hand. Concrete for this widened portion is placed as the machine moves ahead, but the finishing is postponed until after the machine has completed its work. This false form is generally made of wood, although in some instances light steel channels set with the legs down on pins or stakes have been employed. This form of course is pulled after the machine has completed its work.

The information in this article is supplied by the Lakewood Engineering Co.

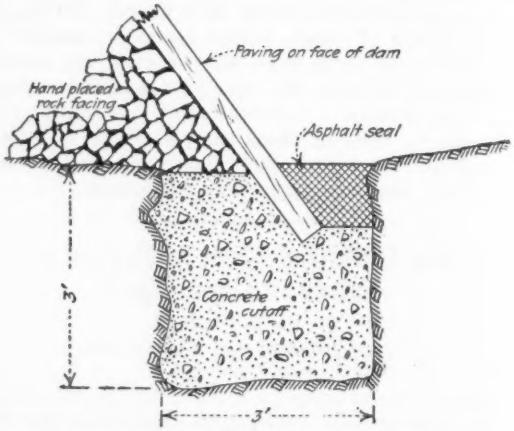
Asphalt Seals Concrete Cutoff in Rock Fill Dam

IN CONSTRUCTING the rock-fill dam which is used by the Southern Sierras Power Co. to increase the natural storage in Rheinedollar Lake, a novel scheme for sealing the upstream toe of the dam with a combination concrete and asphalt cutoff was used as shown in the accompanying sketch.

The rock fill has now been built to a height of 12 ft. and is planned to be carried later to a total height of 30 ft. The dam is founded on solid rock in which, along the toe of the structure, a trench for the cutoff wall was excavated, the trench having a cross-section of about 3x3 ft. Concrete poured in this trench served as a footing and starting point for the reinforced-concrete slab placed on the upstream face of the dam. After the slab had been poured the remaining space

From Job and Office

Hints that Cut Cost and Time



SECTION OF CUTOFF WITH ASPHALT SEAL

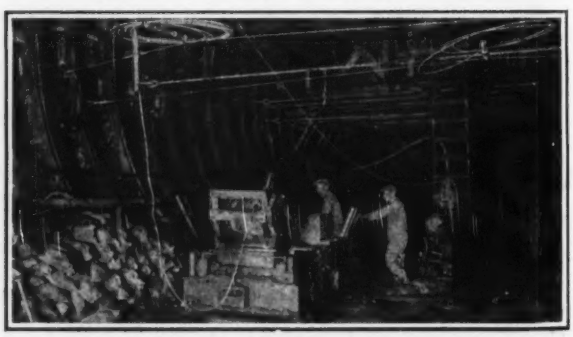
in the trench was filled with asphalt in order to assure the watertightness of the cutoff wall. The concrete slab is 8 in. thick at the bottom, reinforced with heavy wire mesh placed in the center of the slab. The slab was poured on the hand-placed facing of the rock fill, laid up on a ¾ to 1 slope.

Engineering work on this job was handled by F. O. Dolson, president and assistant general manager, Southern Sierras Power Co., field work being under the charge of E. J. Waugh, construction engineer for the company.

Limited Headroom Forces Use of Trolley Reel on Mucking Train Locomotive

IT BEING impossible to run trolley wires clear up to the shield because of obstruction offered by the working platform, the contractors building the Holland tunnels under the Hudson River between New York City and Jersey City equipped the locomotives intended for use in the main headings with a cable reel. In this way locomotives ran ahead of the trolley wire and handled cars directly in front of the shield. This avoided hand tramming to and from the loading point and enabled cars to be moved more rapidly.

The reel consisted of a length of single conductor cable wound on an insulated horizontal drum driven through gearing by a small shunt motor. When it was



LOCOMOTIVE WITH REEL FOR TROLLEY CABLE

From Job and Office

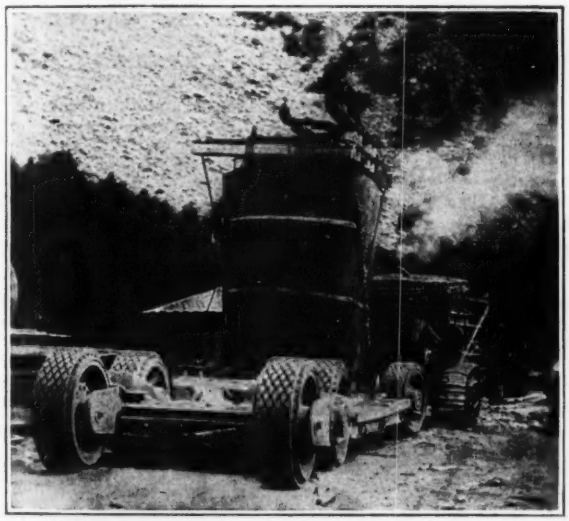
For Contractor and Engineer

necessary to run the locomotive ahead of the trolley wire, a hook on the end of the cable was hung on the wire at the terminal hanger. The driving motor of the reel maintained a constant tension on the cable at all locomotive speeds whether reeling in or paying out. The cable was thus kept off the track and the life of the insulation prolonged. A spooling device was provided with an insulated guide block which was driven back and forth parallel to the face of the drum when the reel was in use, thus guiding the cable onto the drum in even layers.

This electric installation was made by the Westinghouse Electric & Manufacturing Co.

Rubber-Tired Trailer, Capacity 25 Tons, Used by Power Company

THE NEED for a substantial trailer for use in delivering heavy machines to various power plants and in moving heavy equipment generally from place to place on the system led the Southern Sierras Power Co. of Riverside, Calif., to have built specially for this



TRAILER IN SERVICE, DRAWN BY TRACTOR

service a trailer that would safely carry 25 tons. The trailer shown in the accompanying picture was accordingly built to special order in Los Angeles and has been found very useful in the operations of this company.

Because heavy loads frequently have to be transported over city streets or on country highways and because of the weight restrictions per inch width of tire, rubber tires were used and the weight distribution was increased by using four rear wheels, two in tandem on each side. These wheels are 40 in. in diameter and have tires 14 in. wide.

The trailer is equipped with roller bearings throughout; the overall dimensions are 14x7½ ft.; the frame consists of four 6-in., 24-lb. H-beams and the bed is made up of twelve 4-in., 7-lb. I-beams. The weight of the trailer is slightly under 5 tons.

This trailer is not used exclusively on streets and highways. The accompanying picture was taken when the trailer was being used in delivering equipment over the mountain roads leading to the power plant recently constructed on Leevining Creek.

Railway Weeding Machine in France

A WEED cutting and ballast dressing machine which has the unusual feature of cutting off the weeds below the surface of the ballast is giving good results on the Paris, Lyons & Mediterranean Ry., in France, according to a paper by M. Corset, track inspector, in the *Revue Generale des Chemins de Fer*. The knives work horizontally between the ties, being raised to clear each tie by means of a hinged lever which has a small roller at the end. As this roller engages the face of the tie the position of the lever is changed and the mechanism lifts the knives. Fixed plows or blades with notched ends penetrate the ballast on each side of the track. Finally a revolving metal broom dresses the disturbed ballast to the standard cross-section. The knife mechanism is operated from a steam cylinder supplied from the locomotive, while that of the plows and broom is operated by compressed air furnished by the brake pump, the rotation of the brush being effected by a chain gear. With all the mechanism in operation, the machine is pushed over the track at a speed of 2½ to 4 miles an hour, or 5 to 6½ miles when only the plows are functioning. Four men and a foreman form the crew on the machine, which is operated under contract with the company owning the patents. To allow of continuous operation, the work train consists of the weeding machine, a locomotive, two camp cars for the weeding crew and a car for the railroad crew. In 1923 and again in 1924 this railroad operated the weeding machine over about 2,000 miles of track.

Job and Office Notes

"In the Erection Recently of an ice storage building," writes Henry Willcox, Long Island City contractor, "we were obliged to put up an 8-in. concrete wall against an existing brick wall. The brick wall was about 36 ft. long by 30 ft. high, and as the new building was 49 ft. wide by 40 ft. high in the clear, it would have been difficult to brace the forms. Moreover, the concrete was carried up in 14-ft. lifts, and the pressure would probably have burst the brick wall. Accordingly we decided to bolt the form panels to the brick with expansion bolts. A rough test of the holding power of a ⅝-in. shield was made by screwing in the bolt till the brick spalled. This test indicated that holes 2 in. deep would give a large margin of safety. So we laid out our standard form clamp spacing on the brick wall, threaded one end of our clamp rods, and put up the form. It held perfectly. The cost per hole for laying out, drilling, and shield, was about 31c., or 6½c. per sq.ft. of wall. This compares favorably with bracing, even for ordinary story heights. Moreover, the method practically eliminated unbalanced stress in the existing wall."

In Each of the Bascule-Span Piers for the Burnside bridge which is now under construction on the Willamette River at Portland, Ore., 500 piles had to be cut off about 60 ft. below water level. It was found that a contract for having these piles cut off by hand by a diver could be made on a reasonable basis of so much per pile and accordingly no equipment for handling this work was installed on the piledriver barge. The diver who holds this contract, Chris Hansen, uses an ordinary crosscut saw and has for some months been regularly engaged on this job, remaining on the bottom to saw off piles or do other work for continuous periods of three to four hours.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Yellow Crayon for Marking Blueprints

Sir—The plant engineering department of the General Electric Co. has for the past few years used yellow crayon in marking blueprints in place of red crayon used so much by architects and engineers. The yellow crayon was adopted because red against blue is not clearly visible to many people, while the yellow against blue has much greater visibility. Anyone using yellow crayon for marking blueprints I am sure will appreciate its greater visibility.

A. VOGEL,
General Electric Co.

Schenectady, N. Y.,
March 5, 1925.

In Defense of Railroad Concrete

Sir—The editorial under the title "Making Better Railroad Concrete" which appeared in your issue of March 5, 1925, demands an answer. Your castigation of the railroad engineer is not deserving of comment, but the subject of the progress which the railroads have made in the art of concrete construction and the quality of the concrete work to be found on the railroads surely deserves better treatment than accorded it by you.

The railroads were, to a great extent, pioneers in the use of concrete and many of their early structures are now in excellent condition. There is little doubt but that railroad concrete from the earliest examples down to the latest will compare very favorably with concrete used in any other line of engineering. It certainly would seem that the great many examples of track elevation and concrete arch bridges constructed by the railroads in the past decade are deserving of more favorable comment.

Presumably the thought behind your editorial is the practical application of scientific methods of proportioning concrete developed in the laboratories in the last few years. In considering this subject, it must first be borne in mind that these improved methods of making concrete are still in the experimental stage and that within the past two years certain of the conclusions in regard to the laboratory experiments have been considerably revised and as yet there is not a full agreement on the part of the different laboratories carrying on these experiments as to their proper application in actual work.

As to the use on actual work of these new ideas of proportioning concrete, there have been brought before the profession two instances of large building projects where these methods were followed, these being jobs sponsored by the Joint Committee on Concrete and Reinforced Concrete and the use of these methods was strictly an experiment.

In railroad work, three notable examples of scientific proportioning of concrete are to be found in recent work of the Big Four, Central Railroad of New Jersey and the Pennsylvania, and several other railroads have adopted to greater or less extent the same methods.

At the recent convention of the American Concrete Institute, one entire session was devoted to railroad work and there were presented two papers bearing upon railroad work. This is at least no reflection upon the progress of the railroads in concrete work.

In the report of Committee E-6 of the American Concrete Institute, which was also presented at the recent convention, many instances of poor concrete are given, and while there is nothing in this report to indicate that none of these structures were built by railroads, it is quite apparent from the report that very few, if any of them are railroad work. If railroad concrete is so generally poor, it would seem the committee would have been able to find some cases worthy of their notice. There have been several failures of reinforced-concrete buildings and other structures within the past several years, but there has not come to the attention of the writer one case of the structural failure of a concrete railroad structure.

The writer begs leave, therefore, to take issue with you on your statements and to present his belief that concrete work as exemplified on the railroads is as good as if not better than similar work to be found in other branches of engineering and this, in view of the extremely rigid conditions of exposure and of loading to which railroad structures are subjected; that the railroads are today as far advanced in the art of concrete construction as any other branch of engineering; that the railroad engineer will continue to make use of developments in concrete design and construction, when these developments may be applied to the advantage of the efficiency of the structure, and with proper regard to safety, which is the fundamental idea back of railroad engineering

C. C. WESTFALL,
Engineer of Bridges, Illinois Central R.R.

Chicago, Ill.,
March 16, 1925.

[The criticism in the editorial is not subject to exact statistical proof any more than is Mr. Westfall's refutation of that criticism. Both are largely matters of observation and opinion.

In commenting on Mr. Westfall's defense, it may be noted that: first, the railroads cited by him as studying modern methods are the very ones named in the editorial as exceptions to the rule; and, second, that the reason Committee E-6 did not include any railroad structures in its report is that it did not examine any such structures. It is obvious that that committee report only refers to a very limited study and by no means pretends to survey all of the concrete in the United States.—EDITOR.]

Correct Spelling of "Cipolletti"

Sir—For the past thirty years there has been quite consistent mis-spelling of the name "Cipolletti" as applied in American engineering practice to a trapezoidal weir with side slopes of ¼ to 1. Some ten years ago I came across an Italian publication signed by Cesare Cipolletti, whereas, all American text-books on hydraulics and bulletins of experiment stations were spelling the name "Cipoletti" or "Cippoletti." In connection with our work as a special committee on irrigation hydraulics of the American Society of Civil Engineers the question again arose and I contended for a change in spelling, but secured little sympathy. I then wrote to Dr. Luigi Luiggi of Italy, who was unquestioned authority, and from him I have just received the following reply which I believe would be of interest to your readers, particularly those engaged in irrigation or power practice in the West. In his reply after underscoring "Cipolletti" he gives a marginal note as follows:

> "Quite correct. The name comes from Cipolla which means onion. We have a marble called 'Cipollino' of a green color with veins looking much like green onions and Cesare Cipolletti—who was a great friend of mine—is the correct spelling. L. Luiggi."

FRED C. SCOBEY,
Irrigation Engineer, U. S. Bureau of Public Roads.

Berkeley, Calif.,
March 3, 1925.

The Khyber Railway, India

Near completion of the Khyber Ry., beyond the frontier of British India, is noted in the 1924 report of the Government Railway Board. This 28-mile line of 5½-ft. gage has maximum grades of 3 per cent on its first section and then 4 per cent to the summit, the grades being compensated for curvature at the rate of 0.30 per cent for a 7 deg. curve. The elevation is 1,496 ft. above sea level at the lower end, 3,495 ft. at the summit and 2,622 ft. at the terminal. Although there are 32 tunnels their total length is only 2½ miles, the longest being 1,400 ft. Bridges are designed for the latest Indian standard axle load of 24 tons. As the line is in the strip of tribal territory between India and Afghanistan, construction work is under the direction of leading tribesmen, but all skilled labor has had to be imported.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Bureau of Patents Transferred to Department of Commerce

Washington Correspondence

Under the authority of the act establishing the Department of Commerce, President Coolidge has signed an executive order transferring the Bureau of Patents from the Department of the Interior to the Department of Commerce. This transfer was recommended by Secretary of the Interior Hubert Work, and Secretary of Commerce Herbert Hoover. It was recommended among other changes in federal organization, by the joint congressional committee on reorganization.

Transfer of the Bureau of Mines from the Interior Department to the Department of Commerce, by presidential order, is expected to follow the action of President Coolidge.

The organic act of the Department of Commerce gives the President legal authority to transfer to that Department those bureaus whose major purpose is along the line of the Department's function. This administration and its predecessor have been active in an effort looking to the better organization of the executive departments. As an indication of its faith in its policy, it is felt that the administration should carry on reorganization to the extent that it may under the authority already vested in it by Congress.

There also is talk of the transfer of certain functions of the Bureau of Agricultural Economics to the Department of Commerce. While some contend that this can be done under the war-time act authorizing the President to transfer bureaus from one department to another, it is unlikely that any effort will be made, without specific legislation, to transfer any activity of the Department of Agriculture, since the Department of Commerce act specifically excepts the transfer of any activity of the Department of Agriculture. Legislation to that end, however, is expected at the next session of Congress.

Saskatchewan University Engineering Buildings Burn

Word has been received from C. J. Mackenzie, dean of engineering, University of Saskatchewan, that on Friday, March 13, the buildings constituting the engineering group of the university at Saskatoon were totally destroyed by fire. This group contained all the offices, library, lecture rooms and laboratories, and very little equipment of any kind was saved. Dean Mackenzie states that while the inconvenience is very considerable, plans are already being drawn for new buildings, and it is hoped that at least part of these will be available for occupation next fall.

Engineering Fifty Years Ago

From *Engineering News*, March, 1875

ACCURACY of American Civil Engineering.—As the Musconetcong tunnel (just bored through the mountain of that name, on the line of the Lehigh Valley R.R.) is one of the longest this side of the Mississippi, is almost exactly one mile long, the following technical details may be interesting to civil engineers:—

The headings of the tunnel met on the 16th of December, and on testing the alignments, levels, and distance, the following were found to be the errors:—

The alignments tested to four hundredths (0.04) of a foot, or a little less than half an inch.

Levels were run over a mountain 5,000 ft. long, and 450 ft. above grade; also into the tunnel at each end about 2,500 ft., to point where headings met. These tested to fifteen-thousandths of a foot, or less than one-fifth of an inch. The chainings, carried by steel tape measurements over the same distance, tested on the headings coming together to fifty-two hundredths of a foot, or six and four-tenths inches.

Boulder Canyon Hearings Deferred Until Fall

Senate committee hearings on the Boulder Canyon development will begin at Los Angeles on Oct. 26 and will continue at Yuma and Las Vegas. The committee will also visit Boulder Canyon and thence will travel up the river as far as Glen Canyon.

Col. Kelly To Join Niagara Falls Power Co., Is Report

Apparently the small salary increases which were allowed the technical men in the government service by the Reclassification Act are doing little to check the rapid turnover of this class of government employe.

The electrical industry, it is understood, is about to absorb Col. William Kelly, chief engineer of the Federal Power Commission. The salary of his rank is $7,200, which includes commutation of quarters and other army perquisites. It is said that the Niagara Falls Power Co. thinks he is worth three times that amount to it. Reports are heard that he will be made a vice-president of the company with duties largely confined to the engineering side of its operations.

There also is a report that O. C. Merrill, the commission's executive secretary, is about to leave the government service.

President to Name Muscle Shoals Commission Soon

The President intends to announce promptly the names of the members of the Muscle Shoals commission, it was stated at the White House, March 24. Consideration is being given to the advisability of including certain members of the cabinet in the commission's membership. Consideration also is being given to the proposal that the commission consist of five or more members.

As this is written, it is believed that Dr. F. G. Cottrell, the director of the government's fixed-nitrogen laboratory, will be a member of the commission. It also is known that the President is considering very seriously the name of William McClellan, a consulting electrical engineer of New York.

N. J. Professional Engineers Association Holds Meeting

Approximately 500 professional engineers gathered at the Robert Treat Hotel, Newark, N. J., March 18, at the second annual banquet of the New Jersey Society of Professional Engineers and Land Surveyors. That number represents more than 90 per cent of the organization's membership, which is drawn from all parts of the state, and about half of all registered engineers and surveyors in the state. The banquet was the climax to the second meeting of the association, which was held at the Public Service Corporation auditorium during the afternoon. The principal speaker at the banquet was William H. Speer, general attorney for the Public Service Corporation, his subject being the advantages derived from professional society affiliation.

The association was formed a year ago and the meeting of last Friday was the first one attended by the general membership. A constitution and by-laws and a code of ethics were adopted, and E. J. Mehren, vice-president of the McGraw-Hill Co., who was one of the founders of the association, was elected its first honorary member.

Officers were re-elected as follows: president, R. P. McClave; vice-president, Peter Daly; vice-president, F. C. Carstarphen; secretary-treasurer, Hugh A. Kelly.

Baker River Dam Is Now Progressing Rapidly

More than a thousand men were employed on the Baker River dam in Washington early in March and on Mar. 5 concrete had been poured in the structure up to a height of about 70 ft. above bedrock. From now on it is believed that the work is not in danger of further interruption due to wet weather. Stone & Webster, Inc. are the contractors on this job.

Metals Committees of A.S.T.M. Discuss New Specifications and Research

Work on Ferrous and Non-Ferrous Metals—Corrosion Tests of Galvanized Steel and Mosquito Mesh

Meetings of the metals committees of the American Society for Testing Materials were held at the Bellevue-Stratford Hotel, Philadelphia, on March 18-20. The attendance was about 200. New specifications and revisions of existing specifications were considered, and action taken preparing for their presentation to the annual meeting of the society in June. In addition, some large test programs shortly to be carried out were discussed, covering researches in wrought iron, exposure tests of galvanized sheet and wire, and exposure tests of copper and other non-ferrous mesh. A brief review of the principal items of work done at the conference follows:

Wrought Iron—Committee A-2, on wrought iron (Ch., H. J. Force) considered revisions in the specifications for butt welded wrought iron pipe, hollow staybolt iron and staybolts. Plans of a subcommittee to initiate research into wrought iron cover; heat treatment of threaded staybolts to increase their endurance; research into the effect of various percentages of pig iron on wrought iron; and study of heat treatment of wrought iron in general.

Cast Iron—On a report of the chairman of Committee A-3, R. Moldenke, revision of the dimensions of the standard cast-iron test bar was approved, the new diameter being 1.2 in. and the test length 18 in. between supports. There is prospect that international agreement on this size of test bar can be secured, as it already is in use in several European countries.

Steel — New specifications were adopted for structural silicon steel and for valve castings intended for high temperature service by Committee A-1 on Steel (Ch., F. M. Waring). Specifications for cold-rolled strip steel are under discussion. Work is in progress on use of the oxyacetylene flame as a test for the purity of steel. Preliminary agreement has been reached in a subcommittee and is under discussion with government departments to increase the tensile strength of ship steels from the 58,000-68,000-lb. range to the 60,000-72,000-lb. range.

Copper Wire—Committee B-1 (Ch., J. A. Capp) approved an agreement on specifications for copper trolley wire with the American Electric Railway Engineering Association. Joint study of high-strength bronze trolley wire is still in progress.

Heat Treatment—A revision of recommended practice for heat treatment of casehardened carbon-steel objects was agreed upon by Committee A-4 (Ch., H. M. Boylston). The committee also, after study of terms relating to heat treatment prepared by the American Society for Steel Treating, recommended that a joint committee be formed with that society and the Society of Automotive Engineers to draft a series of standard definitions. It also recommended that the initiation of a research on the heat treatment of wrought iron be undertaken.

Non-Ferrous Metals—Committee B-2 (Ch., Prof. William Campbell) adopted revised lists of shapes and sizes of copper wire bars and a revision of the specifications for light aluminum casting alloys.

Corrosion Tests—Three committees concerned with corrosion testing were in session, and all three approved programs for extensive exposure tests.

Committee A-5, on corrosion of iron and steel (Ch., J. H. Gibboney) which has heretofore carried on exposure tests of bare iron and steel sheets, is about to start a remarkably extensive series of exposure tests of galvanized and a few other metal-coated materials. The program for these tests has been under detail study for some time past, and was reported upon at length by F. A. Hull. The exposures are to be made at Key West, Sandy Hook, Pittsburgh, Altoona, and State College, Pa., giving marine, industrial, and country exposures. The sheets are to be tested in 22-gage thickness, full 26-in. width, made of both copper-bearing and copper-free steel, and galvanized in a number of weights of coating. Wire is to be tested in lengths of 22½ ft., using three grades of steel with different weights of coating and different coating processes. In addition, some 32 samples of woven fence and chain link fence are to be exposed, also representing different weights of coating, copper-free and copper-bearing steel, and iron. The same series of tests will cover miscellaneous hardware. Test racks consisting of galvanized steel trusses and purlins on reinforced-concrete posts will be erected. A fund of $10,000 has already been raised to cover the immediate cost of the tests, in addition to which material, test racks, and labor have been donated by a number of organizations.

Committee D-14, on screen wire cloth (Ch., R. W. Woodward) will make exposure tests to determine the relative merits and proper qualities of high-grade screen cloth (copper, bright bronze, low brass, aluminum bronze, silicon bronze, ambrac metal, monel metal). Exposure will be made at Pittsburgh, Portsmouth, Va., Panama, and Washington, in both wooden and copper frames. The resistance to atmospheric corrosion and to wind effect will be tested.

Accelerated corrosion tests covering four types of test (total immersion, alternate immersion, spray, and accelerated electrolytic) and six solutions are shortly to be started by Committee B-3, on corrosion and non-ferrous metals and alloys (Ch., E. C. Lathrop). The main object will be to evaluate the different types of test, but data will be secured also on the relative corrosion resistance of the different metals (nickel, zinc, lead, copper, aluminum and admiralty metal).

Impact Testing — The feasibility of standardizing the practice of routine impact testing of metals was discussed by a subcommittee of Committee E-1. With regard to a more fundamental test, it was decided that research into this subject should be undertaken, if preliminary inquiry shows that the lacking data can be sufficiently defined for the purpose from information now available.

Metals for High Temperature Service—The Joint Research Committee on Effect of Temperature on the Properties of Metals, recently organized, in co-operation with the American Society of Mechanical Engineers, met under the chairmanship of G. W. Saathoff. The discussion was only preliminary, however, designed to lead to the formulation of a test program and to provide the ways and means for carrying out the program. Numerous laboratories are to be invited to join in the test work.

X-Ray Analysis — Committee E-4, on metallography (Chairman, H. C. Boynton) discussed the present scope of X-ray analysis of the internal structure of metals. Recommended practice for X-ray examination is being formulated by a subcommittee under the chairmanship of Zay Jeffries, but its report is not yet complete. Another subcommittee reported recommended practice for thermal analysis of steel, which was adopted.

An address by Dr. Carl Benedicks, director of the Metallographic Institute at Stockholm, Sweden, was a feature of the meeting. Dr. Benedicks' address dealt with X-ray spectrum analysis of martensite, the amorphous theory of hardening, and a hypothesis to account for the practically negligible coefficient of thermal expansion of inva arm, the 36 per cent nickel alloy. He holds that this phenomenon may be accounted for by transformation of alpha iron into gamma iron during the increase of temperature, this transformation being accomplished by contraction in volume.

Licensing Bill Pending in Ohio Legislature

A bill to register professional engineers and land surveyors has passed the Ohio State Senate. It is now in the house and, according to latest information, will undoubtedly be passed by that body. Two years ago the same bill was defeated in the Ohio Legislature, largely because of opposition of the Engineers Club of Cincinnati. This year the Engineers Club has stayed out of the fight.

In a recent issue of the *Bulletin* of the Engineers Club of Cincinnati, it is stated "that we favor the registration of land surveyors who perform work for public record, but to embody under the terms of one bill professional engineers and land surveyors is a pretty big 'bite.' The public has not demanded such a measure and the majority of professional engineers are opposed to it as having no merit to the public or to themselves."

Albany Port Bill Passed by Both Houses of State Legislature

The Byrne-Hall bill creating the Albany Port District has been passed by both houses of the New York State Legislature. It is practically a substitute bill for an earlier one to create an Upper Hudson Port District, noted in our issue of March 12, p. 453, which met with much opposition from the cities located on the Hudson and Mohawk Rivers above Albany which were included in the district and subject to assessments for public works to be constructed, for the most part, at Albany.

The new bill includes only Albany and Rensselaer lying on the east bank of the river opposite Albany. The bill creates a port commission, a body corporate of five members with wide powers to develop the port, issue bonds, construct and operate transportation facilities within the port.

Hearings on Philadelphia Subway Bid Suit Held

Hearing on the injunction suit to restrain Mayor Kendrick and Director Ehlers from awarding the $16,000,000 contract for the Broad St. subway section from Stiles to Filbert Sts., Philadelphia, to other than the low bidder, was conducted by the judges of Common Pleas Court No. 1 Tuesday, March 25.

There will be no award of the contract by the transit department pending the suit seeking the injunction against the award to the Keystone State Construction Co., the second low bidder. The transit department has returned to all except the two low bidders, the checks deposited with their bids as evidence of good faith.

The low bid submitted by the New York syndicate, composed of Fred L. Cranford, Inc., Charles H. Locher and Winston & Co., is for $16,449,936, plus $300,000 on "force account," a total of $16,749,936. The Keystone State Construction Co. bid $16,863,436.75. Because the syndicate submitted a check for $825,000, and did not include in the check the 5 per cent deposit on the $300,000 item of the force account work City Solicitor Gaffney advised Transit Director Ehlers to reject the low bid as irregular and illegal. The Cranford syndicate later submitted an additional check to cover the alleged force-account shortage.

It was in consequence of this action that a taxpayers' suit seeking an injunction against the Keystone State Construction Co. being given the award, was instituted in the name of Carl J. Harris, No. 431 West Penn Street, a property owner.

Interstate River Control in Northwest Proposed

The North Dakota Legislature has passed a bill for a Red River Interstate Commission to consist of two members each from North Dakota, South Dakota and Minnesota and one or two representing the United States, to consider the problem of flood control of the Red River. A similar bill has been introduced in Minnesota, but South Dakota has taken no action and is not so much interested as the other states. This Red River problem was described in *Engineering News-Record*, July 26, 1923, p. 133 and July 28, 1921, p. 140. A similar bill providing for a Missouri River interstate commission was passed in North Dakota two years ago; this commission to consist of members representing North Dakota, Montana and South Dakota, but the latter two states have taken no action.

Illinois Water-Works Officials Hold Joint Meeting

The seventeenth annual meeting of the Illinois Section of the American Water Works Association met March 17 and 18 at Evanston with the Iowa and Wisconsin Sections. One session at which more than 100 were present was held jointly with the Water Treatment Plant Operators Conference. The topics covered treatment plants at Evanston, Hinsdale, Springfield, Ill., and Orlando, Fla.; Diesel engine practice, quick boiler water analysis, metering effects, the large reserve necessary in small towns to meet fire demands and a highly interesting paper by J. J. Hinman, Jr. on water supplies for domestic animals, a subject the analyst is frequently confronted with.

K. C. Bardwell, superintendent, water supply, Chesapeake & Ohio R.R., explained the standard methods of making rapid tests of boiled water analysis as recommended by the American Railway Engineering Association. This is one of the subjects the Standardization Council of the A. W. W. A. asked the section to discuss. With minor changes and much reluctance to go back to the archaic "grains per gallons" method of reporting results the methods seemed to the section to be satisfactory for industrial work. Both "parts per million" and "grains per gallon" will probably be included in any recommendation which the water-works officials would sanction.

C. S. Timanus, assistant engineer, Burns & McDonnell, consulting engineers for the Springfield plant, described the combined softening and iron removal plant for well water or river water. The plant is just being started. Paul Hansen, of Pearse, Greeley & Hansen, detailed the reasons for the recent doubling of the capacity of the Evanston filters and W. W. Matthews, of Alvord, Burdick & Howson, spoke of the combined water and light plant at Orlando, Fla. Charles Streithof, general manager, Evansville, Ind., has metered nearly all of his 18,560 services at a cost of $249,000, thereby reducing consumption from 124 to 74 gal. per capita daily. The saving in the consumers' bills is sufficient to finance the meter cost in 2½ years.

The newly-elected officers are as follows:

Chairman, L. R. Howson; vice chairman, W. R. Gelston; treasurer, H. E. Keeler; trustee, H. M. Ely. The next meeting will probably be in Springfield since the Water Treatment Operators Conference chose that city and that city only made a bid for the next meeting.

U. S. Commerce Commission Undertakes Rate Investigation

Acting under authority of the Hock-Smith resolution, the Interstate Commerce Commission has undertaken an investigation of the rate structure of railroads subject to the Interstate Commerce Act to determine to what extent and in what manner, if any, rates and fares in interstate or foreign commerce for various classes of commodities and traffic including freight, passenger, mail, and express may be unjust, discriminatory, or preferential, or otherwise in violation of law; to determine to what extent existing rates cause undue advantage between localities in intrastate commerce on the one hand and interstate or foreign commerce on the other, or unjust discrimination against interstate or foreign commerce. The commission will also make such changes in rates as may be found necessary to correct any defects found and to determine to what extent and upon what classes of commodities or traffic compensating increases or other changes in rates may be required in order to offset or partially offset such reductions or other changes in rates as may be necessary to make.

In its work the commission is to give due regard to the conditions which prevail in the several industries of the country to the end that commodities may freely move; the general and comparative levels in market values of commodities as indicated over a reasonable period of years; a natural and proper development of the country as a whole; the maintenance of an adequate system of transportation; and other requirements of law laid upon the commission in respect to the initiation, modification or adjustment of rates. It is also to effect, with the least practicable delay, such lawful changes in the rate structure as will promote the freedom of movement of the products of agriculture, including livestock, at the lowest possible lawful rate compatible with the maintenance of adequate transportation service.

American St. Lawrence Engineers Have Field Work Plan

While the allotment of this summer's field work on the St. Lawrence cannot be made until the Joint Engineering Board can meet, the American members of the board have in readiness a tentative plan covering the field work which they probably will be called upon to do. Unless there should be some unexpected delay in the diplomatic interchanges which are in progress, the probabilities are that field work can begin as soon as the river is free of ice.

The American engineers already have drawn up specifications for the contract borings. Immediately following the meeting with the Canadian engineers they will let emergency contracts, which will enable them to take full advantage of the rather short working season.

In addition to the diamond drilling there must be wash borings to determine the character of material to be excavated in canal construction and at the points where channel enlargement is contemplated.

Mead To Stay With Reclamation Bureau Another Year

Washington Correspondence

Failure of Congress to discharge a moral obligation to Dr. Elwood Mead will not cause the Commissioner of Reclamation to resign at this time, despite widely published statements to the contrary. Dr. Mead was receiving a salary of $11,000 as professor of rural institutions at the University of California. An emergency situation arose in federal reclamation and he was appealed to as the man best fitted to save the day. He pointed out to the Secretary of the Interior that he already had contributed more generously to the public service than he could afford and that he owes it to his family to make no further contributions of his time at pay allowed by the government.

Secretary Work urged him to take the place and promised to do all in his power to obviate any sacrifice of remuneration. He initiated legislation proposing that "the salary of the Commissioner of Reclamation be $11,000." Congress failed to act on it at that session. It was taken up again at the last session. It was discussed ad lib. with consequent delay. Finally the amount was reduced to $10,000 and made an item in the Department's appropriation bill. In the wrangle over the conference report on that bill there was failure to agree on that paragraph. It will mean, however, that Dr. Mead will return to the University a year hence. He hopes in that time to be able to launch his program, which is set forth in part in the Kendrick bill. It is contended, however, that the new policy should be guided by his experienced hand, after it has been put into effect. Some harsh things are being said as to the pound wisdom and penny foolishness of Congress in refusing to pay an admittedly competent man $11,000 to direct a $200,000,000 enterprise.

North Dakota Engineers Hold Joint Meeting

A joint annual meeting of the North Dakota Society of Engineers and the North Dakota chapter of the American Association of Engineers, held at Bismarck, N. Dak., on March 13 and 14, was a very successful affair. These two societies have no official affiliation, but their memberships overlap to some extent and and for some time they have been working in co-operation, with their officers acting voluntarily as a joint board. Among the papers presented were the following: "Missouri River Diversions," J. N. Roherty, State Highway Commission; "Red River Valley Flood Control," E. V. Willard, Minnesota Drainage Commission, and Prof. E. F. Chandler, University of North Dakota; "The Engineers' License Law," H. C. Knudsen, State Highway Commission; "The A. A. E. National Convention," E. J. Budge, State Highway Commission; "The Bismarck Filtration Plant," Thorne Dickenson, assistant city engineer; "Power Plants," D. Oslund, manager, Ottertail Power Co., Jamestown; "Power Development of 1924," J. H. Wiley, assistant engineer, Board of Railroad Commissioners; "Transmission Line Development in North Dakota," E. H. Morris, chief engineer, Board of Railroad Commissioners; "Development in Concrete and the Design and Control of Mixtures," M. Bergsford, field engineer, Portland Cement Association; "The North Dakota Highway Problem," Stanley R. Sharts, highway engineer, U. S. Bureau of Public Roads.

Officers of the North Dakota Society of Engineers were elected as follows: President, E. S. Keene, Fargo; vice-presidents, J. A. Wallace and J. A. Jardine; secretary, P. M. Barnes, Valley City. For the North Dakota chapter A. A. E., Thorne Dickenson, Bismarck, was elected president.

Grand Canyon Feature Is Named Stanton Point

On Feb. 4 the U. S. Geographic Board approved the name Stanton Point for a very striking feature on the south rim of the Grand Canyon directly opposite Powell Plateau. The point was named in honor of the late Robert Brewster Stanton, who died in 1922. Mr. Stanton was a member of the American Society of Civil Engineers and of various other scientific and technical associations. He was the leader of an expedition which in 1889 and 1890 surveyed the Colorado from the point where the Green River enters it in Utah to the Gulf of California. Mr. Stanton's chief purpose in making that survey of the Colorado was to demonstrate the availability of the Colorado terrain as a roadbed for a railroad, and his expedition adduced the first full topographic data on that interesting river.

James Hartness Seriously Ill

James Hartness, former governor of Vermont and president of the American Engineering Council, is seriously ill in Boston. His physician, Dr. J. Delinger Barney, in a statement says:

"I think that with careful attention Mr. Hartness can be pulled through. He is, however, in extremely poor condition and it will require our best efforts to cope with the situation."

Mr. Hartness has undergone two operations for bladder trouble since he first placed himself under Dr. Barney's care in Boston on Feb. 26.

Tennessee Rejects $75,000,000 Road Bond Issue

A bill recently introduced into the Tennessee Legislature calling for a referendum on a $75,000,000 road bond issue for state highway construction has failed of passage in both houses. Accordingly, the state highway department will shape its road construction work to conform to a "pay-as-you-go" plan. It is probable that $10,000,000 can be raised yearly from auto licenses and gasoline taxes. The legislature recently raised the gasoline tax from 2c. to 3c. per gallon, all funds so derived to go into the general highway fund for construction and maintenance.

Random Lines

Why, Asks a Reader, the Abnormally Low Pressure?

Hampered by the united populace of Long Island City, Woodside, Winfield, Elmhurst, Corona and Flushing demanding their Saturday night baths and water on Sunday morning for church, city engineers completed a spectacular feat of engineering yesterday afternoon when they cut at Fisk and Maurice avenues, Winfield, the high pressure main which, forty-eight inches in diameter, brings water at a pressure of ninety tons a square inch to this section from the Catskills.—*New York Herald-Tribune.*

* * *

Asking a Lot of a Civil Engineer

Sir—The following ad once appeared in the Pittsburgh papers:

WANTED—Civil Engineer for construction work in the Wheeling district. Young man preferred. Must be able to read blue prints. Write C-219 Chronicle Telegraph.

Evidently professional qualifications are high in the "Wheeling District."

C. L. P.

* * *

A New Drafting Process

From a story in the Satevepost.

"Brought up some plans for a fact'ry in Albany my uncle's lettin' me fool with. Stewed over 'em in the train. Tires your eyes out."

"Why do architects use blue paper so much?" Myra asked, leaning her elbows on the register. "Is it really better than white?"

He spoke of blue paper for drafting, and then he mentioned the use of white inks.

* * *

A. S. B. E. Meets in Chicago

Two weeks ago the American Railway Engineering Association met in Chicago. But they were not the only engineers to enjoy the hospitality of the western metropolis. The American Society of Bakery Engineers was meeting the same week at the Hotel Sherman.

* * *

Momentum—Mass X Velocity

An automobile could be driven through the world's largest siphon, which is nearing completion on the outskirts of Washington, D. C. It is to be used for the Great Fall conduit, which will supply water to the national capital and is expected to be ready for operation in May. This single siphon is sufficient, in a stretch of twenty-nine miles of piping, to give the water momentum enough to reach its destination.—*Popular Science Monthly.*

* * *

Tracing—A piece of linen used for taking high spots off erasers. R. W. E. in *The Rochester Engineer.*

Seattle Defeats City Manager and Other Charter Changes

An amendment to the city charter of Seattle, Wash., proposing the city-manager plan, was defeated at the city election March 10. The vote stood 26,942 against and 22,470 for the plan, giving a negative majority of 4,472. Of the 294 election precincts, 211 voted against, 5 tied and 78 voted for the plan. Three other charter amendments met heavy defeat and one was carried. The other amendments defeated were for salary increases (councilmen from $3,000 to $4,800 and the comptroller and the treasurer from $4,200 to $5,000). The successful amendment removed the one-mill limit on the park fund levy. A $2,500,000 school bond issue was carried three to one but a referendum ordinance appropriating $172,000 for the relief of Boxley Cañon flood victims of 1919 was defeated.

Although the total number of ballots cast (not votes for any single measure) was the highest in any strictly municipal "off year" election, only 56,419 of the 118,210 persons registered went to the polls, or under 48 per cent, while but 49,412 voters, or 42 per cent of those registered, expressed themselves on the city manager plan.

Opposition to the manager plan centered partly in the fact that it was brought before the voters as a charter amendment instead of a new charter, framed by a board of freeholders elected for the purpose. Some of those in opposition are said to believe in the manager plan, if incorporated in a complete new charter (the present one has been amended repeatedly since its adoption in 1896), although some of these would be against a manager unless he was subject to popular recall. Steps looking to a new charter are already under consideration.

H. F. Janda Made Assistant Highway Board Director

Announcement is made by Charles M. Upham, director of the Highway Research Board of the National Research Council, of the appointment of H. F. Janda as assistant director. Mr. Janda is a graduate of the University of Wisconsin, and for two years was assistant city engineer at Portage, Wisconsin. He has not only had a variety of practical experience in engineering, but acted as instructor and assistant professor of civil engineering at the University of Cincinnati for five years. As associate professor of highway engineering at the University of North Carolina for three years he was in charge of experimental research in co-operation with the state highway commission.

Mr. Janda has carried on many important research projects, including capillary moisture in highway subgrades, earth pressure tests on culvert pipe, and other problems affecting highway construction.

Mr. Janda is located in the offices of the Highway Research Board in the building of the National Academy of Sciences and National Research Council, Washington, D. C.

Engineering Societies

Calendar

Annual Meetings

AMERICAN WELDING SOCIETY, New York City; Annual Meeting, New York City, April 22-24, 1925.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Louisville, Ky., April 27 to May 2, 1925.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Convention, Chicago, May 12-14, 1925.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Convention, Orlando, Fla., June 2-5, 1925.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J., June 22-26, 1925.

The Dayton Section of the American Society of Civil Engineers has recently had two interesting lectures: On Feb. 9 an illustrated lecture on "Aerial Mapping" by Lieut. Plank of McCook Field, and March 9 on "Reminiscences of Fifteen Years of Street Railway Work," by E. D. Smith, maintenance engineer of the National Cash Register Co.

Personal Notes

J. H. WEBSTER, JR., surveyor in the Bureau of Surveys, Philadelphia, Pa., and a member of the board of engineers for the construction of the Delaware River bridge, has resigned his position in the survey bureau after service there since 1891. He is succeeded by Amos B. Engle, who has been a principal assistant in the bureau.

J. B. W. GARDINER, of Gardiner & Lewis, Inc., New York City, announces that his connection therewith has been terminated and that he has organized his business under the name of J. W. B. Gardiner, Inc., and will continue the production and sale of waterproofing asphalt, waterproofing fabric and asphalt emulsion at 50 Church St., New York City.

WILLIAM H. SUTHERLAND, minister of public works of British Columbia, has been appointed also minister of railways. J. E. GRIFFITH, formerly deputy minister of public works, was appointed chief engineer and deputy minister of railways. PATRICK PHILIP, public works engineer, was made also deputy minister of public works.

MAJOR W. G. SWAN, chief engineer of the Vancouver Harbor Commission, has resigned and has entered private practice as consulting engineer at Vancouver. Major Swan's early work, after graduation from Toronto University, was with the Canadian Northern Ry. He was consecutively transitman, resident engineer, bridge engineer, and district engineer. His service in France during the World War was first with the Canadian railway troops, and later chief engineer and in charge of maintenance of light cavalry with the Second British Army. For the past five years he has been with the Vancouver Harbor Commission. In consulting practice he will specialize on reports and appraisals of all kinds of construction.

ARTHUR L. MUDGE, Toronto, Ont., has been appointed to the staff of the Joint Board of Engineers, Canadian Section, St. Lawrence waterways project. Mr. Mudge was lately associated with Kerry & Chace, Ltd. He has had engineering experience extending over a period of thirty years in the designing of power plants. His duties in connection with the St. Lawrence River investigation will be the preparation of plans and specifications for four possible power plants for the development of the river. Mr. Mudge is a McGill University graduate of 1894.

NORMAN D. WILSON, of Wilson & Bunnell, consulting engineers, Toronto, Ont., is in Brazil in connection with making a report on the street railway systems of Rio Janeiro and São Paulo for the Brazilian Traction Light & Power Co.

CARL F. UHDEN, formerly chief engineer of the Gorge Creek development of the city of Seattle's hydro-electric project on the Skajit River, has entered private practice as consulting and contracting engineer with offices at 1409 Alaska Building, Seattle.

E. L. FILBY, sanitary engineer of the South Carolina State Board of Health since 1919, has resigned effective April 15, and has accepted the position of director of the Bureau of Sanitary Engineering of the state of Florida. He succeeds George W. Simons, Jr., who has resigned to enter private practice. Mr. Filby, a Cornell graduate, is president of the South Carolina chapter of the American Association of Engineers.

J. WEBSTER HOOVER, civil engineer, Everett, Wash., has been appointed state highway engineer, succeeding JAMES ALLEN, who has been highway commissioner and supervisor of highways for the last nine years but recently resigned to accept a position in California. Mr. Hoover was city engineer of Everett for seven years.

Obituary

EDWIN I. FARNSWORTH, Kansas City, Mo., retired civil engineer, who served two terms on the board of public works and one on the fire and water board, died March 14 at the home of a relative, aged 84 years. Mr. Farnsworth was born in Indiana and in 1865 graduated in civil engineering from De Pauw University. His early work was in bridge building at Leavenworth, Kan.

STEPHEN J. GETTINS, assistant city engineer at Toledo, Ohio, died at his home in that city after several weeks' illness, aged 49 years. He had been an assistant city engineer for twenty years.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Eliminate Another Paving Brick Variety

"Recognized" Sizes Now Total 4 — Manufacturers Report Growing Demand For Thin Brick

At its fourth revision conference in Washington March 20, the permanent Committee on Simplification of Varieties of Paving Brick eliminated one additional variety, thus reducing the "recognized" varieties to four.

The variety eliminated from the "recognized" list is the 3x3½x8½-in. wire-cut lug brick. The varieties now remaining as "recognized" are as follows: Plain wire-cut brick (sometimes called vertical fiber lugless), 3x4x8½ in. and 3½x4x8½ in.; repressed lug brick, 4x3½x8½ in.; wire-cut lug brick, 4x3½x8½ in.

The particular variety eliminated was dropped because it came under the rule adopted by the committee last year, to the effect that any variety in which the shipments for three successive years had fallen below 2½ per cent of the total shipments should be eliminated from the "recognized" list. The variety in question had represented 2.1, 2.3 and 2 per cent of the total shipments in the years 1922, 1923 and 1924 respectively.

The committee's attention was called in half a dozen letters from manufacturers to the increasing demand for a plain wire-cut brick 2½ in. deep. These manufacturers expressed the belief that this variety should be included in the recognized list. Shipments of the variety were 2.2 per cent, 2.7 and 4.4 per cent in the years 1922, 1923 and 1924 respectively, the quantity shipped in 1924 being 17,500,000 brick. However, the committee's rule requires that a variety, in order to enter the "recognized" list, must show shipments for three successive years, of 5 per cent of the total. Under this rule the 2½-in. brick would not be accorded recognition and the committee held that there was not sufficient reason for departing from the rule. The variety, therefore, was not advanced to the "recognized" class.

The survey made in anticipation of the meeting showed that of the shipments in 1924, 84.1 per cent were in the five recognized varieties.

The organization represented at the meeting were the American Society for Testing Materials (Prof. T. R. Lawson); American Ceramic Society (O. U. Renkert); Bureau of Standards (Dr. P. H. Bates); Bureau of Public Roads (V. M. Peirce); National Paving Brick Manufacturers Association (Edward E. Duff, Jr.); U. S. Chamber of Commerce (E. W. McCullough); Department of Commerce (H. R. Colwell). E. J. Mehren, vice-president, McGraw-Hill Co., chairman of the committee, presided.

Each Imported Shingle Must Bear Stamp of Origin, Treasury Rules

Washington Correspondence

A ruling has been issued by the Treasury Department regarding marking imported shingles and flooring boards to indicate the country of origin to the effect that each individual shingle and board must be so marked.

The Treasury decision was rendered in view of an opinion expressed by the Board of General Appraisers in a case involving the question of whether shingles and flooring boards had to be marked with the country of origin at all, or not. The Treasury practice had been that one mark on each bundle or bunch was sufficient. In its decision, the board expressed the opinion that each individual article should be marked.

Because the new decision involves a change of practice, 30 days grace has been given before it will become effective.

National Lime Association to Meet May 26-29

The seventh annual convention of the National Lime Association and the twenty-third annual meeting of lime manufacturers will take place on May 26 to 29 inclusive at Briarcliff Lodge, Briarcliff Manor, New York. The meeting will follow the lines of the annual meeting last year at White Sulphur Springs, West Virginia, with the mornings and some of the evenings devoted to reports of work accomplished during the past year, results of fellowships, as well as talks on manufacturing problems. It is proposed to hold another round-table research conference on one evening.

There will be ample time set aside for sports, such as golf, tennis, swimming, horse-back riding, quoits, and a baseball game, and the meeting will be concluded with a banquet and entertainment.

Motor Vehicles Used by Missouri Highway Department

In connection with its short instruction course on highways for employees, the State Highway Department of Missouri has collected data relating to the motor vehicles which form part of its field equipment. The following notes are from a statement by B. H. Piepmeier, chief engineer:

The Missouri Highway Department now has under way $30,000,000 worth of construction and a system of 7,640 miles of state roads to be maintained. The Department pays the upkeep and operation cost on 811 motor vehicles, 224 of which are passenger cars, 431 trucks, and 156 tractors. Of the 224 cars in use, 179 are Fords; of this number, 158 are Ford roadsters with a light delivery body on the rear instead of the original turtle back. Cars such as these serve two purposes: They provide transportation and a means for carrying engineering supplies. Of the 224 passenger cars in use, 8 are assigned to headquarters in Jefferson City, 195 are in use in the field by division engineers, right-of-way men, project engineers, material men, etc., and the remaining 21 are in use on maintenance.

Water-Works Manufacturers Meeting Set for April 29

The annual meeting of the Water-Works Manufacturers Association will be held at the Brown Hotel, Louisville, Ky., April 29, at 10:30 a.m. This session will be held during the American Water Works Association Convention in the same city. Further details regarding the manufacturers' meeting will be announced at the convention.

Paving Brick Shipments Start Spring Climb

Shipments of vitrified paving brick showed a slight increase for February over January, according to the monthly statistical report of the National Paving Brick Manufacturers Association made to the U. S. Department of Commerce. Shipments for February were 5,613,000 as against 4,198,000 for January.

With only 29 companies reporting for February as against 31 for January there was a marked increase in stock on hand with a decrease in production and unfilled orders. The 29 companies represent 68 per cent of the normal tonnage capacity of the industry. They reported production for February at 62 per cent of their normal monthly tonnage capacity.

Unfilled orders stood at 49,692,000 on the last day of February.

Lumber Standardization Conference to Be Held May 1

May 1 has been set as the opening date of the general lumber standardization conference with Secretary Hoover in Washington, according to an announcement by the chairman of the central committee on lumber standards, John W. Blodgett. It is believed that this meeting, which will be the third general conference held during the past three years, will bring to a successful conclusion the program of standardization of the soft wood lumber industry. The move to bring about standardization was inaugurated by Secretary Hoover in May, 1922. Under the auspices of the National Lumber Manufacturers Association and upon its invitation Secretary Hoover called the first meeting.

From time to time the central committee on lumber standards has submitted specific recommendations covering standard lumber classifications, yard lumber sizes, methods of lumber measurement and provision for protecting the consumer.

At the conference May 1, representatives of lumber manufacturers, whole-

salers, retailers, architects, contractors, engineers, railroads, and wood using industries, as well as various government departments, will attend.

Mixer Manufacturers Bureau Re-Rates 21-E Paver 24-E

As the result of information gathered from a questionnaire submitted highway contractors, the Mixer Manufacturers' Bureau, affiliated with the Associated General Contractors of America, has re-rated the 21-E paver and hereafter will designate it 24-E. The new rating permits a seven-bag batch, 1:1½:3 mix, or a six-bag batch on a 1:2:3½ mix.

The re-rating does not involve a mechanical change in the mixer, as all mixers of this size which conform to the standards of the bureau will take the new rating. The change is to more accurately designate the mixer. The paving mixers designated standard and approved as such by the Associated General Contractors now are the 7-E, the 13-E and the 24-E.

February Ford Car Sales

Retail sales of the Ford Motor Co. during February, exclusive of those in Canada and British possessions served by the Ford Motor Co. of Canada, Ltd., totaled 125,421 Ford cars and trucks and 7,211 Fordson tractors. Of these, the retail deliveries in the United States reached 112,526 Ford cars and trucks and 5,914 Fordsons.

Business Notes

LEHIGH PORTLAND CEMENT CO., Allentown, Pa., which has sixteen mills in operation throughout the country, has recently purchased the new plant being erected by the Bath Portland Cement Co., along the Delaware, 6 miles above Easton, Pa., and also leased the home plant of the same company at Bath. Each of the newly acquired mills has a capacity of 1,000,000 bbl. a year. John Barnes, Philadelphia, president of the Bath Portland Cement Co., and Fred B. Franks, vice-president, are also the principal stockholders of that company.

J. M. DIVEN, JR., formerly with the Kelly Well Co., Grand Island, Neb., has joined the sales organization of the Leadite Co., Inc., Philadelphia, Pa.

S. FLORY MANUFACTURING CO., Bangor, Pa., manufacturer of mine and contractors' hoists, ship auxiliaries, cableways, dredging and slate working machinery, has recently established the following new sales agencies: Philadelphia, Service Supply Corporation; Detroit, American Machinery & Equipment Co.; Chicago, Rennolds Equipment Co.; Columbus, O., W. W. Williams Co.; Huntington, W. Va., La Lance Equipment Co.; Pittsburgh, Contractors Machinery & Supply Co.; San Francisco, A. L. Young Machinery Co.; Los Angeles, Franklin Machinery & Supply Co.; Baltimore, Md., Jewell Supply & Equipment Co.; Richmond, Va., J. S. Potts, Jr. & Co.; Norfolk, Va., Empire Machinery & Supply Co.; Charlotte, N. C., Lloyd B. Lent. A new catalog will be issued shortly and the company plans to establish additional agencies as part of a sales campaign.

FRANCIS C. PRATT, vice-president in charge of engineering of the General Electric Co., has been appointed to fill the vacancy caused by the resignation of G. E. Emmons, as vice-president in charge of manufacturing and chairman of the manufacturing committee. Mr. Pratt's new title will be vice-president in charge of engineering and manufacturing. H. F. T. Erben, who has been appointed assistant vice-president on the staff of Mr. Pratt, will continue as vice chairman of the manufacturing committee. Mr. Pratt's engineering assistant is E. W. Allen, appointed manager of the engineering department in April, 1924.

C. B. STARR has joined the Robert June engineering management organization of Detroit, Mich. Mr. Starr is a graduate of Cornell University with the degree of M.E. He was assistant mechanical engineer with the Duff Manufacturing Co., Pittsburgh, and later served as sales engineer with the Detroit office of the Wayne Tank & Pump Co.

PREMIER EQUIPMENT CORPORATION, Houston, Tex., has recently been incorporated as successor to the Houston Railway Car Co. P. R. Plumb is retiring from the Houston Railway Car Co. and the members of the new firm are L. A. Wiltshire, formerly of the Birmingham Rail & Locomotive Co., Birmingham, Ala.; O. D. Cleveland, Equitable Equipment Co., New Orleans, La.; and M. R. Ducey, Houston Railway Car Co., Houston, Texas. The company is equipped to buy, sell, and repair cars and locomotives, as well as to buy and sell rails and industrial equipment.

BRADFORD H. WHITING has severed connections with Whiting Corporation, Harvey, Ill., and its subsidiary, Grindle Fuel Equipment Co., because of illness. In addition to holding a directorship in both companies Mr. Whiting was vice-president and general manager of the Whiting Corporation and president of the Grindle Fuel Equipment Co.

WILLIAM L. SAUNDERS, chairman of the board of the Ingersoll-Rand Co., has been awarded the honor cup of the University of Pennsylvania, given each year to the most distinguished alumnus. Mr. Saunders was graduated from the institution in 1876.

SICKEL WATER PRODUCTION CO., Aurora, Ill., reports that it has established a branch office at Wausau, Wis., in charge of Ben A. Hochtritt, who until recently was water superintendent for that city.

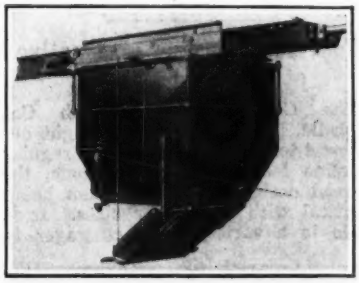
CLARENCE MAXWELL GARRIGUES, son of a member of the firm of Levering & Garrigues, New York, fabricators of structural steel, died on March 13. He had been on the sales force of the firm since his graduation from Princeton in 1920.

Equipment and Materials

New Features of Measuring Batcher Offer Enlarged Use

A number of new features have been incorporated in the 1925 design of the adjustable measuring batcher manufactured by the Blaw-Knox Co., Pittsburgh. The sand and stone batchers are interchangeable, so that a greater latitude in their use by the contractor is offered. The lower section of the batcher is built to a true square so that it may be turned and replaced on the upper cone, enabling the discharge gate to open in any direction. This allows the contractor to suit delivery of measured batches to the requirements of his particular plant layout.

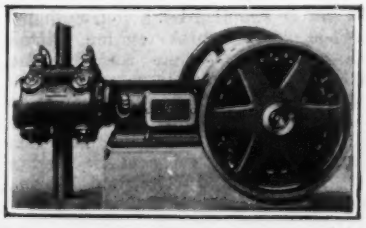
Other features include a semaphore indicator which automatically operates with loading or discharging and a non-jam strike-off gate operating on roller



wheels mounted on a track. The latter feature allows material to be struck off and the bin discharge closed with a single motion of the operating lever. The electrically-welded construction of the batcher gives a smooth interior and the slope of 60 deg. or more insures clean discharge.

Direct-Connected Synchronous Motor Drives Compressor

A direct-connected synchronous motor of the fly-wheel type for air compressors has been put on the market by the Chicago Pneumatic Tool Co., New York City. This type motor is available in sizes ranging from 139 to 1,000 cu.ft. displacement and for discharge pressure from 100 to 125 lb. This new line of synchronous motors is known as the fly-wheel type and is especially designed for single straight-line air-compressor operation. The motor is designed with the rotating element outside the stator. The stator is mounted in a cradle support bolted to the compressor frame, the cradle support being bored concentric with



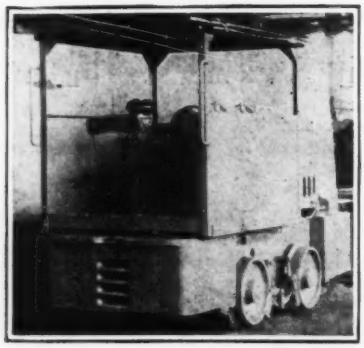
the compressor bearing to assure perfact alignment of the stator and a uniform air gap when assembled. The rotor presents the appearance of an ordinary fly-wheel, its face being crowned for driving an exciter or other auxiliary and the inner surface of the rim carrying the poles.

Maintenance of a uniform air gap because of its relative smallness in this motor has been met by designing the stator so that the magnetic pull is upward, relieving bearings of excessive downward pressure. In addition, the main bearings of the compressor are fitted with removable die-cast bushings which may be quickly and cheaply replaced at the first sign of wear.

In the new design weight and consequently cost have been greatly reduced; sufficient fly-wheel effect for steady, smooth operation has been secured, and a uniform, correct air gap has been obtained. The floor space required to accommodate such an installation is less than if belted to a line shaft and at least 30 to 75 per cent less than that required for short-belt motor drive.

Four-Ton Gasoline Locomotive of Standard Design

The George D. Whitcomb Co., Rochelle, Ill., has recently brought out a new 4-ton locomotive built to regular gasoline locomotive specifications, the general design and construction being identical with the larger sizes. It is made in a variety of track gages to



meet various construction and industrial needs in road building, quarries, sand and gravel plants and industrial and manufacturing works.

The height over the engine is 54 in., the height over the cab 81 in., the wheelbase 36 in., and the length approximately 9 ft. It is built upon a solid cast-iron chassis and the whole unit weighs approximately 8,000 lb. with an average drawbar pull of 1,600 lb. Coil springs are provided on each journal box, giving an easy riding action.

Power is supplied by a four-cylinder 4¼x4¼-in. Continental engine, fitted with a Dixie magneto and impulse starter. This engine is rated from 30 to 40 hp. at 1,200 r.p.m. and from 45 to 48 hp. at 1,800 r.p.m. There are no exposed drives. The coupling device is arranged to allow for coupler heights of 9½ in., 12½ in., 15½ in., and 18½ in., which will care for all standard cars.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Effect of Pittsburgh Plus Removal Upon Price

Mill Shipments in Chicago District and Pittsburgh Steel F.O.B., New York Higher Than In July, 1924

Since the order issued July 22, 1924, by the Federal Trade Commission, terminating the use of the Pittsburgh-plus system by the United States Steel Corporation, prices of structurals at New York and Chicago warehouses have remained consistently below the July, 1924 levels, while mill shipments are higher, as shown by the following tables:

STEEL STRUCTURALS, MILL SHIPMENTS, F.O.B., PER 100 LB.

	Chicago		New York	
	1924	1925	1924	1925
January	$2.60	$2.20	$2.84	$2.10
February	2.60	2.30	2.84	2.39
March	2.60	2.30	2.73	2.44
April	2.50	....	2.63	....
May	2.45	....	2.58	....
June	2.38	....	2.54	....
July	2.27	....	2.43	....
August	2.20	....	2.34	....
September	2.06	....	2.34	....
October	2.00	....	2.27	....
November	2.15	....	2.34	....
December	2.20	....	2.44	....

STEEL STRUCTURALS AT WAREHOUSE, PER 100 LB.

	Chicago		New York	
	1924	1925	1924	1925
January	$3.30	$3.10	$3.64	$3.34
February	3.30	3.10	3.64	3.34
March	3.30	3.10	3.64	3.34
April	3.30	....	3.64	....
May	3.30	....	3.59	....
June	3.30	....	3.59	....
July	3.30	....	3.44	....
August	3.10	....	3.34	....
September	3.10	....	3.34	....
October	3.10	....	3.34	....
November	3.10	....	3.34	....
December	3.10	....	3.34	....

Mill shipments of structurals, f.o.b., Chicago, were $2.27 per 100 lb. in July, 1924, at the time the order went into effect. The following month the price dropped to $2.20. At the present time, however, the market is $2.30, f.o.b. Chicago, 3c. per 100 lb. above the July level.

Practically the same movement occurred in New York as in Chicago. Mill shipments from the Pittsburgh district, f.o.b. New York, were $2.43 per 100 lb., in July, 1924. August quotations were $2.34. Current mill shipments from Pittsburgh are $2.44 per 100 lb., f.o.b., New York.

The Chicago warehouse price was $3.30 per 100 lb. for structurals in July, 1924. The price dropped to $3.10 in August and has remained at that level since then.

The superiority of bank debits over clearings as an index of business activity, will be explained in an article by Geo. B. Roberts of the Federal Reserve Bank of New York, to appear in an early issue of Engineering News-Record.

The New York warehouse quotation was $3.44 per 100 lb. for structurals in July, 1924. The following month the price fell to $3.34, which figure is still in effect at local warehouses.

It is evident then that the mill shipment quotations, while they receded at the same time as warehouse prices, have crept back to levels higher than those in effect before the abolition of the Pittsburgh plus.

This has had the effect of narrowing down the profits at the dealers' warehouses. The placing of even moderate tonnages with mills instead of warehouses, has been encouraged by prompt deliveries from the former, made possible by the high rate of output and availability of freight cars.

Other effects of the removal of the Pittsburgh plus have been: (1) the

(*Continued on p. 544*)

Plumbing, Heating, Lighting and Painting Costs Compared

Four of the most important building cost items, plumbing, heating, lighting and painting, have been separated from the total money value of Industrial and Commercial building contracts and compared for the years 1923 and 1924.

Industrial construction for the United States during these two years totaled $281,621,000 and $204,969,000 respectively. The minimum contract included in these totals is $40,000.

Of the four items under industrial building, the installation of the heating equipment reaches the largest total, while painting operations come second.

Commercial Building awards with minimum contract of $150,000 amounted to $934,905,000 in 1924 compared with $841,936,000 for 1923.

As in industrial construction, heating involves the greatest expenditure of money of the four items under consideration.

The second operation as to the expensiveness of outlay in commercial building is that of lighting. This is due to elaborateness of this type of structure. The cost of the four operations is greater in commercial than in industrial contracts.

PLUMBING, HEATING, LIGHTING AND PAINTING COST OF BUILDINGS

	Industrial Buildings		Commercial Buildings	
	1923	1924	1923	1924
Plumbing	$1,464,429	$1,065,838	$16,838,720	$18,698,100
Heating	10,138,356	7,378,884	42,096,800	46,745,250
Lighting	7,800,901	5,677,641	29,467,760	32,721,675
Painting	8,899,223	6,477,020	16,838,720	18,698,100
Totals	$28,302,909	$20,590,383	$105,242,000	$116,863,125

Use of Average Bids in Handling Minor Items on Estimates

Supplementary to a tabulation of average bid prices covering minor items on subway estimate sheets, published in the Feb. 26 issue of *Engineering News-Record*, p. 377, the following has been prepared.

These items vary little from a standard price and the average is derived from the three lowest bids occurring in estimates on a given number of sections of New York subway and tunnel construction.

The use of the average bid will guide, if not eliminate, the guesswork usually involved in minor items on estimate sheets. The table was compiled by Alexander Lyle, Assoc. Mem. Am. Soc. C.E.

Business Briefs

Call money ranged from 3½@4 per cent, March 23.

Time loans: short terms, 4 per cent; longer periods, 4¼ per cent.

Commercial paper: best names, 4 per cent; other names, 4¼ per cent.

Foreign exchange (Demand):

	Normal	This Week	Last Week	Year Ago
Sterling..	$4.8665	$4.77⅞	$4.78⅛	$4.29⅛
Franc ...	.193	.0520⅛	.0514¼	.0535⅛
Lira ...	.193	.0406¼	.0408⅜	.0430⅛
Mark ...	.238	.238	.238	.....

Contract Letting in U. S. From Week to Week

The following totals do not include any awards under $15,000 for waterworks or excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial buildings.

ENGINEERING NEWS-RECORD STATISTICS

Week of	Public Work	Private Work	Total Contracts
Mar. 19, 1925	$16,809,000	$21,533,000	$38,342,000
Mar. 12, 1925	19,114,000	29,411,000	48,525,000
Feb. 19, 1925	20,863,000	27,401,000	48,264,000
Mar. 20, 1924	17,126,000	31,125,000	48,251,000
Heaviest Week Last year			
May 8, 1924	30,319,000	38,829,000	69,148,000
This year, Mar. 12, 1925	19,114,000	29,411,000	48,525,000

It will be seen from the above figures that there is a slight recession in current contract letting, compared with the three periods mentioned.

Industrial lettings are slightly heavier than during the week of Mar. 12 and considerably under those of a month ago in number and value of awards.

Lettings for large public buildings of a commercial type are greater in number and value than those of a month ago or one year ago.

Gains are noted in waterworks, bridges (public) and excavations (private). These three classifications, together with sewers and Federal Government work, are all ahead of last month's figures for the corresponding week. Gains compared with a year ago are also observed in waterworks, bridges and Federal projects.

Hoover Sees No Business Recession

Washington Correspondence

Business in Europe continues to gather momentum. Our own production shows no decreases. Everyone has a job. For these reasons Commerce Secretary Hoover takes no stock in the talk of business recession. Business, he says, always has an attack of nerves when such highly speculative things as wheat and railroad stocks have set backs. Neither the decline in wheat prices nor the difficulties of the Chicago, Milwaukee & St. Paul have general significance Mr. Hoover be-

(*Continued on p. 544*)

UNIT BID PRICES ON SUBWAY AND TUNNEL WORK

Classification	Unit	No. of Sects.	Bid Price Maximum	Bid Price Minimum	Bid Price Average	Per Cent Ratio Max. to Min.
Miscel. wt. iron ladders, fixtures, etc.	Lbs.	2	$0.15	$0.10	$0.12	150
Special wire forms	Lbs.	5	1.00	.15	.33	667
Wire mesh	Ton	3	500.00	110.00	197.78	455
Copper steel plates, bolts & washers	Ton	3	350.00	89.00	152.89	394
Non corrosive metal hangers	Lbs.	2	1.00	.35	.70	286
Bronze fixtures, bolts, hinges, etc.	Lbs.	3	1.25	.35	.79	358
Asbestos—¼ in. lumber	Sq.ft.	4	14.00	.20	1.69	7,000
Handrail—1½ in. Oak or Ash	Lin.ft.	4	.90	.30	.52	300
Steel gratings for ventilation	Sq.ft.	5	6.00	2.00	3.09	300
Vault lights	Sq.ft.	5	4.00	2.00	2.68	200
Restoration—sidewalks within curb	Sq.yd	7	6.00	1.00	3.00	600
Restoration—new cement sidewalk	Sq.yd.	1	5.00	3.50	4.00	143
Restoration—asphalt pavement	Sq.yd.	5	12.00	3.00	5.24	400
Restoration—granite block pavement	Sq.yd.	7	13.00	2.50	5.12	521
Restoration—new granite block pavement	Sq.yd.	1	8.00	7.00	7.67	114
Restoration—wood block pavement	Sq.yd.	1	14.00	7.00	9.67	200
Restoration—curbing	Lin.ft.	1	1.50	1.00	1.17	150
New bluestone curbing—6 in.	Lin.ft.	5	3.50	1.50	2.09	233
New granite curbing—8 in.	Lin.ft.	3	6.50	3.00	4.37	216
Restoration—N.Y. Central tracks	Lin.ft.	1	15.40	10.00	13.47	154
Const. & finish upper 3 in. conc. walls & slabs	Sq.yd.	4	7.00	1.50	2.77	467
Furnish & setting trees	Each	2	80.00	10.00	38.33	800
Remove & deliver memorial trees	Each	1	108.00	25.00	72.67	433
Wt. iron or steel elec. conduits—¾ in.	Lin.ft.	8	.60	.14	.33	428
Wt. iron or steel elec. conduits—1 in.	Lin.ft	8	1.00	.18	.44	555
Wt. iron or steel elec. conduits—1¼ in.	Lin.ft.	3	.80	.20	.49	400
Wt. iron or steel elec. conduits—1½ in.	Lin.ft.	7	1.00	.25	.59	400
Wt. iron or steel elec. conduits—2 in.	Lin.ft.	3	1.00	.45	.84	222
Wt. iron or steel elec. conduits—3 in.	Lin.ft.	3	2.00	.65	1.20	308
C. I. outlet boxes	Each	8	4.00	.16	1.61	2,500
C. I. pull boxes	Each	5	20.00	3.00	6.27	667
Galv. iron pull boxes—4x4x3 in.	Each	3	4.00	.30	1.78	1,333
Galv. iron pull boxes—6x6x4 in.	Each	3	4.90	.35	2.78	1,400
Galv. iron pull boxes—12x12x6 in.	Each	1	10.00	5.00	8.00	200
Steel splicing boxes—36x30x7 in.	Each	1	12.00	10.00	10.67	120
Galv. iron fixtures, curb guards, etc.	Lbs.	3	.30	.09	.13	333
Galv. iron light boxes	Each	1	20.00	5.00	12.67	400
C. I. pipe & specials—3 in. ex. hy.	Lin.ft.	5	5.00	1.00	1.80	500
C. I. pipe & specials—4 in ex. hy.	Lin.ft.	5	5.50	1.20	2.13	458
C. I. pipe & specials—6 in. ex. hy.	Lin.ft.	8	6.25	1.40	2.25	446
C. I. pipe & specials—8 in. ex. hy.	Lin.ft.	7	10.00	1.50	3.13	667
C. I. pipe & specials—10 in. ex. hy.	Lin.ft.	3	5.40	2.50	3.26	216
C. I. pipe & specials—12 in. ex. hy.	Lin.ft.	3	6.50	3.00	4.10	216
Vitrified pipe sewer—12 in.	Lin.ft.	5	5.50	1.90	3.76	289
Vitrified pipe sewer—15 in.	Lin.ft.	6	10.00	3.60	5.48	277
Vitrified pipe sewer—18 in.	Lin.ft.	4	12.00	3.75	6.54	320
Vitrified pipe sewer—20 in.	Lin.ft.	2	10.00	4.50	7.47	222
Vitrified pipe sewer—22 in.	Lin.ft.	1	10.45	5.50	8.65	190
Vitrified pipe sewer—24 in.	Lin.ft.	4	11.00	6.00	7.64	183
C. I. pipe sewer—straight	Ton	5	210.00	80.00	134.13	263
C. I. pipe sewer—specials	Ton	5	400.00	110.00	203.33	364
3 ft. 6 in.x2 ft. 4 in. reinf. concrete sewer	Lin.ft.	5	35.00	10.00	17.21	350
3 ft. 0 in.x3 ft. 0 in. reinf. concrete sewer	Lin.ft.	1	42.00	14.80	26.60	284
4 ft. 0 in.x2 ft. 6 in. reinf. concrete sewer	Lin.ft.	2	42.00	13.20	23.30	318
3 ft. 6 in.x3 ft. 9 in. reinf. concrete sewer	Lin.ft.	1	50.00	14.80	31.60	338
4 ft. 0 in.x4 ft. 3 in. reinf. concrete sewer	Lin.ft.	1	59.00	16.65	35.22	354
4 ft. 3 in.x5 ft. 0 in. reinf. concrete sewer	Lin.ft.	2	68.00	18.30	34.89	371
4 ft. 9 in.x5 ft. 0 in. reinf. concrete sewer	Lin.ft.	1	75.00	20.40	45.80	368
4 ft. 6 in.x2 ft. 10 in. reinf. concrete sewer	Lin.ft.	1	45.00	16.30	30.43	276
5 ft. 0 in.x6 ft. 0 in. reinf. concrete sewer	Lin.ft.	1	80.00	24.70	39.90	324
6 ft. 0 in. circular reinf. concrete sewer	Lin.ft.	1	50.00	40.00	46.00	125
7 ft. 6 in.x9 ft. 6 in. reinf. concrete sewer	Lin ft.	1	180.00	83.00	121.00	217
Support & reconst. elec. overhead trolley	Lin.ft.	2	10.00	4.00	6.54	250
Temp. relocation of elec. overhead trolley	Lin.ft.	1	10.00	5.00	7.00	200
Underpinning elev. cols. inside N. L.	Each	1	2,133.33	666.67	1,178.00	320
Underpinning elev. cols. outside N. L.	Each	1	1,240.00	400.00	680.00	310
Changing water pipe—4 in.	Lin.ft.	1	2.00	1.00	1.67	200
Changing water pipe—6 in.	Lin.ft.	8	3.25	.63	1.51	524
Changing water pipe—8 in.	Lin.ft.	6	4.00	1.00	2.29	400
Changing water pipe—10 in.	Lin.ft.	1	2.00	1.25	1.50	160
Changing water pipe—12 in.	Lin.ft.	5	5.00	1.35	2.44	370
Changing water pipe—16 in.	Lin.ft.	4	10.00	1.80	4.06	555
Changing water pipe—20 in.	Lin.ft.	2	17.00	2.00	7.50	850
Changing water pipe—30 in.	Lin.ft.	2	12.00	3.50	5.70	344
Changing water pipe—36 in.	Lin.ft.	1	12.00	5.00	7.33	240
Changing water pipe—48 in.	Lin.ft.	1	15.00	6.00	9.67	250
Service connections for water pipe	Each	5	150.00	20.00	39.53	750
New C. I. water pipe—6 in.	Lin.ft.	1	1.00	.50	.72	200
New C. I. water pipe—8 in.	Lin.ft.	1	1.25	.60	.90	209
New C. I. water pipe—10 in.	Lin.ft.	1	1.50	.70	1.08	215
Changing C. I. gas pipe—3 in.	Lin.ft.	1	2.00	.40	1.13	500
Changing C. I. gas pipe—4 in.	Lin.ft.	7	3.00	.50	1.42	600
Changing C. I. gas pipe—6 in.	Lin.ft.	7	5.00	.60	1.85	833
Changing C. I. gas pipe—8 in.	Lin.ft.	3	6.00	1.00	2.93	600
Changing C. I. gas pipe—10 in.	Lin.ft.	4	8.00	1.00	2.89	800
Changing C. I. gas pipe—12 in.	Lin.ft.	5	10.00	1.25	3.13	800
Changing C. I. gas pipe—16 in.	Lin.ft.	2	8.00	1.60	4.23	500
Changing C. I. gas pipe—20 in.	Lin.ft.	3	10.00	2.00	5.02	500
Changing C. I. gas pipe—24 in.	Lin.ft.	2	25.00	3.00	7.94	833
New C. I. gas pipe—4 in.	Lin.ft.	1	.90	.45	.62	200
By pass pipe W. S.—4 in.	Lin.ft.	3	6.00	2.00	4.12	300
By pass pipe W. S.—6 in.	Lin.ft.	2	8.00	3.50	6.08	228
By pass pipe W. S.—8 in.	Lin.ft.	2	13.00	5.00	8.25	260
By pass pipe W. S.—10 in.	Lin.ft.	1	9.00	6.00	8.00	150
By pass pipe W. S.—12 in.	Lin.ft.	2	20.00	6.00	10.67	333
By pass pipe W. S.—16 in.	Lin.ft.	1	15.00	8.00	11.67	188
By pass pipe W. S.—20 in.	Lin.ft.	2	30.00	10.00	15.83	300
By pass pipe W. S.—24 in. above street	Lin.ft.	1	22.00	10.00	17.50	220
By pass pipe W. S.—4 in.—above street	Lin.ft.	1	12.50	7.00	10.17	179
By pass pipe W. S.—6 in.—above street	Lin.ft.	1	14.00	8.00	11.33	175
By pass pipe W. S.—8 in.—above street	Lin.ft.	1	15.00	9.00	13.00	167
By pass pipe W. S.—10 in.—above street	Lin.ft.	1	16.00	10.00	14.00	160
By pass pipe W. S.—12 in.—above street	Lin.ft.	4	25.00	4.00	12.26	500
By pass pipe W. S.—16 in.—above street	Lin.ft.	2	20.00	10.50	15.09	191

Weekly Construction Market

LUMBER is the one item in this week's market to show definite firmness in price. Long-leaf yellow pine is up $1 in New York and Douglas fir timbers, $1.50 per M. ft. b.m., in Seattle.

In other materials, such as structural rivets, wrought-steel and cast-iron pipe, brick and linseed oil, there is weakness.

The price of common brick in New York is now $17 to $18 per M., delivered at site of job, depending upon haulage distance. The present level is about that of September and October, 1924, and is $6 per M. below a year ago. When the Northern yards re-open in the spring there will probably be a reduction in wages of brickyard labor.

Telegraphic reports to *E. N.-R.* from the Pacific Northwest show considerable improvement in that section over conditions existing there during the past three months.

The employment situation and the weather are both much better, with increasing demand for men in farming sections, logging camps and on construction projects.

Reports from the lower Southern states claim that considerable pine "on the stump" has been so affected by recent droughts as to necessitate immediate cutting of the trees in order to save the lumber. The throwing of such large quantities of yellow pine upon the market may seriously affect the price.

The present weakness in domestic c.-i. pipe is due largely to close competition from foreign makers.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb	$3.34	$3.90	$4.15	$3.10	$3.35	$3.07½	+$3.30	$3.35	$4.25
Structural rivets, 100 lb	4.50	4.45	4.75	—2.75	3.75	4.65	5.00	—3.60	6.00
Reinforcing bars, ¾ in. up, 100 lb	3.24	3.40	3.38	—2.70	3.25	3 87½	3.35	3.25	2.30
Steel pipe, black, 3½ to 6 in. lap, discount	48%	53.2%	43%	56½%	54.25%	36%	44.7@55.5%	—50%	59 49
Cast-iron pipe, 6 in. and over, ton	—52.60@53.60	56.00	56.00	49.20@50.20	55.50	62.00	53.00	55.00	60.00
Concreting Material									
Cement without bags, bbl	2.50@2.60	2.30	2.05	2.20	2.42	2.84	2.31	2.65	1.80
Gravel, ¾ in., cu.yd	1.75	1.90	2.38	—2.75	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd	1.25	1.40	2.00	—2.75	1.25	1 00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.85	2.00	2.83	—2.75	1.75	2.50	2.15	3.00	2.25
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	+61.00	34.00	56.00	—39.00	39.75	35.75	30.00	+25.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	+25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.50@2.75	1.45	1.85	—1.21	1.35	2.70	1.60	2.80	10.50
Common brick, delivered, 1,000	—17.00	10.50	12.10	12.00	12.50	12.00	15.50	14.50	17.50
Hollow building tile, 4x12x12, per block	Not used	.0808	.0941	.06	.07	.085	.....	.11	.12
Hollow partition tile 4x12x12, per block	.1162	.0808	.0941	.06	.....	.085	.108	.11	.10
Linseed oil, raw, 5 bbl. lots, gal	—1.14	—1.20	1.30	1.25	1.21	1.33	—1.24	1.12	1.11
Common Labor									
Common labor, union, hour	.75	.30	.....	.82½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.75	.50@.55	.35@.50	.50	.50	.20@.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; lump finishing lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of March 5, the next on April 2.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.90). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

Effect of Pittsburgh Plus Removal Upon Price

(*Concluded from p. 542*)

formation of new basing points in the several branches of the steel industry; (2) localization of buying in the district covered by each basing point; (3) enlargement of mill capacity in the Chicago district; (4) agitation in the direction of a change in freight rates on steel shipped from the Pittsburgh and Youngstown districts to Western markets.

Hoover Sees No Recession

(*Concluded from p. 543*)

lieves. Since eighty-five per cent of the wheat is out of the farmers' hands, wheat price is largely a specultative proposition.